

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

150th Session (1937-8)

Part 3

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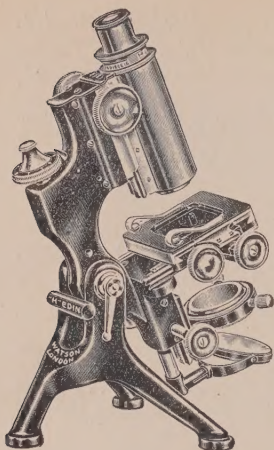
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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

150th Session (1937-8)

Part 3

PROCEEDINGS OF THE GENERAL MEETING 17 March 1938

Mr. J. RAMSBOTTOM, O.B.E., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 3 March 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—James Smith, Lionel John Farnham Brimble, and Ronald Melville.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Roger Fielding Notcutt, Mohammed Admeduddin Anwer, and James Brady.

Mr. H. W. PUGSLEY, F.L.S., discussed *Myriophyllum alterniflorum* var. *americanum* in Ireland.

Abstract.—

Mr. H. W. PUGSLEY exhibited a specimen of *Myriophyllum alterniflorum* DC. which he had collected last August in Lough Beg, in Ireland, and a similar example obtained in the adjacent Lough Neagh in 1867, which alike differ widely from the usual form of the species as seen in Europe and match the plant occurring in north-east America which American botanists regard as typical *M. alterniflorum*. The exhibitor pointed out the interest of this plant, which he had proposed to name var. *americanum*, as an addition to that

small group of North American species found in Ireland and not known in Continental Europe (among which the most quoted are *Spiranthes stricta* and *S. gemmipara*).

Discussion :—

Mr. A. J. WILMOTT remarked that of the two *Spiranthes* mentioned incidentally by Mr. Pugsley the one from the Lough Neagh area was the plant common throughout the northern United States and Canada, whereas that from Cork and Kerry could only be matched by plants from Newfoundland and the Gaspé peninsula, i.e. the area of preglacial relicts. Since so many Irish botanists had before the discovery of *Spiranthes* by Lough Neagh been over the very ground on which it is plentiful, it had seemed possible that the northern *Spiranthes* might in some way have been introduced recently. The specimen of the *Myriophyllum* collected by Stewart in 1867 was therefore of special interest, having been collected so long before the *Spiranthes* was discovered.

Dr. R. MELVILLE said that Mr. Pugsley has made an interesting addition to the list of plants common to both North America and Europe, and one which raises again the question of how this type of distribution has been brought about. It is a notable fact that the majority of such plants are aquatics or favour damp situations, and most of them have small and light seeds. The possibility of bird transport is worth consideration, particularly as recent work has shown that certain species of duck that normally migrate from the United States to Iceland occasionally visit parts of western Europe and the British Isles instead of returning along their usual route. Here is just such a chain of circumstances as may account for the distribution on the two continents. The statement that the plant is absent from Iceland is especially interesting in the light of this theory.

Mr. PUGSLEY replied that the aquatic flora of Iceland had not been thoroughly worked out, and *Myriophyllum alterniflorum* var. *americanum* may yet be found there.

Dr. W. B. TURRILL, F.L.S., gave an account, illustrated with numerous herbarium specimens, of 'Problems of British *Taraxaca*'.

Abstract.—

It is well known that many, and probably the vast majority, of the dandelions of north-western Europe are apomictic, in the sense that they set seed without fertilization. It follows that characters 'come true from seed', apart from the rare occurrence of somatic mutations and allowing for the high degree of plasticity due to the interaction of different

environmental factors with any one genotype. The taxonomically non-committal term biotype is here used for a group of plants all the members of which have apparently the same genetic constitution. The problem of how the biotypes in the genus *Taraxacum* occurring in the British flora can best be treated taxonomically is a difficult one and cannot be finally answered until much more research has been completed. It is, however, desirable to consider the facts that have been accumulated by recent research, and to state as concisely as possible the lines along which further research is most likely to give valuable results.

The genus, as usually defined, is relatively distinct morphologically and cytologically from other genera of the Compositae, and the name *Taraxacum* is nomenclaturally conserved. The monograph of Handel-Mazzetti (1907) with the Nachträge includes 63 species classified into 10 sections. Five of the species accepted in the monograph have been recorded from the British Isles: *T. palustre* (Lyons) Lam. & DC., *T. balticum* Dahlst., *T. officinale* Web., *T. laevigatum* (Willd.) DC., and *T. obliquum* (Fries) Dahlst. On the other hand, over 100 biotypes have been listed by names or described with names for the British flora. These can be classified into four more or less satisfactory sections: *Erythrosperma*, *Obliqua*, *Palustria*, and *Vulgaria*.

Since apomixis is a character of so many of the biotypes of *Taraxacum* it is necessary to consider briefly the process of seed production in the dandelions. The experimental and cytological investigations of Raunkiaer, Ostenfeld, Murbeck, Juel, Rosenberg, Ikeno, Sears, Gustafsson, and others have made the essential details clear. *Taraxacum* has a basic chromosome number of 8. Many, but not all, biotypes retain the same chromosome number (some multiple of 8, constant for the biotype) throughout the life-history. Seeds, with viable embryos, are produced by the development of (usually) an unfertilized egg into a zygote and this into an embryo, without any nuclear fusion or change in chromosome number. The group *Vulgaria* is triploid (24 chromosomes); *Erythrosperma* is triploid and occasionally tetraploid (32 chromosomes); *Palustria* is tetraploid; *Obliqua* is triploid; *Spectabilia* is tetraploid and occasionally pentaploid (40 chromosomes); *Ceratophora* is triploid and tetraploid; *Arctica* is probably hexaploid (48 chromosomes). All the British material grown at Kew and so far examined cytologically is triploid (sections *Vulgaria*, *Erythrosperma*, and *Obliqua*). The polyploidy is found to be allopolyploidy (i.e. consisting of multiples of different chromosome sets), and this suggests an origin of the biotypes in connection with primary hybridization.

Research in the Herbarium Experimental Ground at Kew with over 100 stocks of *Taraxacum*, mostly representing different biotypes, has shown, by 'castration' experiments and by other means, that all British *Taraxaca* so far tested are apomictic. On the other hand, several amphimictic dandelions are known and several (non-British) have been grown at Kew. It is probable that the numerous biotypes did not arise separately as the direct result of hybridization or of abnormal chromosome behaviour, but that primary hybridization preceded apomixis, which was followed by mutation. Mutations, probably rare relative to the number or potential number of offspring, are at once 'fixed' by apomixis, in the sense that mutational characters reappear in all the offspring.

It is important in studies on *Taraxacum* to know as much as possible about the wide range of plasticity shown by any one genotype. Dandelions are amongst the most plastic of plants, and all parts, especially the leaves, show great variation with different environmental conditions. There is no doubt as to the morphological distinctness of numerous biotypes. These have quite definitely a genetic basis, but the characters change greatly with different habitat conditions, with season, and with age of the plants—both with age from the seedling and from rejuvenated crowns. Light and soil conditions, age of plants or crowns, and development of earlier leaves have been shown by experiments at Kew to be important factors interacting with the genetic constitution to modify leaf-shape.

Populations of *Taraxaca* vary in their biotype composition in different parts of the British Isles, and there is a fairly high correlation between habitat preferences and some, but not all, sections and biotypes. Populations in natural or semi-natural habitats are much more uniform (in biotype composition) than in disturbed, waste, or ruderal areas. A sand-dune area, a chalk grassland, or a limestone ridge has a much less diversified dandelion population than many a much smaller area of broken field, waste ground, or newly made up verge or embankment.

It is suggested that research should be concentrated especially on the following:—

1. Intensive investigation of wild populations on a statistical basis.
2. Extensive field-studies undertaken with the aim of tracing the geographical and ecological ranges of biotypes and the recording of character-combinations and character-distribution.
3. Searching for evidence of mutations, sexuality, and hybridization.

4. Cultural experiments by growing rows of plants from seeds from single heads of known origin and with full recording of characters at all stages of the life-history.

5. Experiments to determine apomixis (or amphimixis) and range and control of plasticity.

Until really sound data are available it seems undesirable to adopt more than a tentative scheme of classification and nomenclature for the British biotypes of *Taraxacum*. By multiplying specific and varietal names for the biotypes merely on the basis of phenotypic differences of unknown value, nomenclature within the genus will become unwieldy, if not a farce. It is therefore suggested that names should at present only be given so far as they are likely to be a useful aid in collecting and filing data, and that sectional names should be used with or without binomials of the standard of Handel-Mazzetti or the 'agamospecies' of Turesson, and that, under the sections, biotypes should be named provisionally as such, but not as species. These biotypes show certain of the characters of species (as usually accepted by taxonomists) and many of the characters of varieties. The widespread and regular occurrence of apomixis puts them into a category distinct from both 'species' and 'varieties'. Experimental and cytological proof of apomixis justifies a given biotype being called an apomict, and this can then be done without any change of name.

[A fuller paper, with bibliographical references, has been accepted for publication in the Botanical Exchange Club's 1937 Report (1938).]

Discussion :—

Professor F. E. WEISS expressed his interest in Dr. Turrill's communication and referred to the peculiar quilled dandelion which he found on the Cheshire hills some 12 miles from Manchester. This was obviously a mutation from the normal, and being apomictic spread freely in his garden, into which it had been transplanted. A parallel mutation, but in a different species, was found in the Swiss Alps.

Mr. A. J. WILMOTT said that we should be grateful to Dr. Turrill for his studies of Dandelions. He had long felt that they were worse than *Hieracia*, which did not seriously change from youth to age and from season to season. Cultivation was absolutely necessary, since in the field one often could not tell whether two plants were of different kinds or only two stages of one kind. He remarked that stylose forms occurred also in several different *Hieracia*, in some species commonly and in others more rarely; the phenomenon did not seem to have there anything to do with species-formation.

Mr. J. S. L. GILMOUR asked Dr. Turrill if there was any evidence at present as to whether those apomictic populations which had arisen through mutations had done so once, and then spread to their present distributions, or had originated several times by parallel mutation.

Mr. H. W. PUGSLEY remarked that, while the genus *Hieracium* presented similar phenomena and difficulties in classification, it was a much larger natural group which afforded more numerous criteria for classification and had been much more intensively studied over a relatively long period.

In replying to questions asked in the discussion Dr. TURRILL said that he had not made a special study of *Hieracium*, but that he thought the problems were not entirely the same in this genus as in *Taraxacum*. Apomixis was certainly common to both genera, but the biotypes of *Hieracium* were, on the whole, probably less plastic than those of *Taraxacum*, and usually grew in more natural habitats less disturbed by man.

It was impossible to say how often parallel mutations occurred or had occurred, but they were probably rare. The selective action of different environments was sometimes marked and might account for the failure of some mutations, parallel or otherwise, to become established in a given area, whether by origin *in situ* or by immigration.

Capt CYRIL DIVER, F.L.S., gave an account, illustrated with lantern-slides, of 'The plant-carpet in relation to animal distribution'. [Printed in full below.]

The President added some comments.

The following paper was read in title :—

'Contributions towards the fungus flora of Uganda. II. Meliolineae—Supplement.' By C. G. HANSFORD, M.A., F.L.S. [This paper will be printed in the Journal.]

THE PLANT-CARPET IN RELATION TO ANIMAL DISTRIBUTION*.

By Capt. C. DIVER, F.L.S.

It has long been a biological commonplace that the composition of the plant-carpet, considered in broad terms, is an important factor in limiting the distribution of animals. Two obvious examples may be given. Phytophagous species are ineluctably confined to the neighbourhood of places where

* Contributions towards a Survey of the Plants and Animals of South Haven Peninsula, Studland Heath, Dorset, No. 6.

suitable food-plants grow; the limitation imposed on this group has a secondary effect upon the distribution of its predators and parasites; and so on through the complicated ramifications of the food-chains. The nature of the leafy canopy imposes equally important limitations by modifying the micro-climatic conditions below it: conditions under a clump of trees are quite different from those at its margins. But the importance to animal life of the fine structure of the plant-carpet and the valuable information that can be derived from it has received curiously little attention.

The field-naturalist knows that until he has acquired experience in how, when, and where, to look for the species in a particular group he will not succeed in finding a large proportion of those species which live in the place he is working. Put in another way this means that fine shades of difference will determine whether or not a particular species can occupy a habitat. This fact, since it is as true of plants as it is of animals, can be of great value to the ecologist who has to assess and classify the varied habitability of a piece of country. For plants are sedentary organisms and many can be recognized at any season of the year; so, if their ecological requirements and vegetative behaviour are known, they provide valuable 'markers' from which a generalized picture of the conditions in any locus can rapidly be drawn.

In a survey concerned with more varied problems than the direct study of a single specialized community, two different aspects (sometimes differentiated by the terms synecology and autecology) must be considered. It is not only necessary to know which species live together in the same community, but also why they are present in one though absent from another. An understanding of synecological grouping presupposes an autecological knowledge of the requirements of the component species. To arrive at this knowledge a division of the survey area into its main 'locus-habitats' is essential; and it is the object of the present paper to outline how this may be done, what attributes must be considered in doing it, what part is played by the plant-carpet both in creating these attributes and in providing ready and often delicate indicators of slight physico-chemical changes, and, lastly, how this classification when made can be used to interpret distributional facts. The instances given are drawn from the South Haven Peninsula Survey (Diver & Good, 1934) which has now been in operation for six years.

THE DIVISION OF THE AREA.

South Haven Peninsula, which is the major part of what is known as Studland Heath, lies in the south-east corner of Dorset, and forms the southern of the two arms guarding the

mouth of Poole Harbour. During the last 300 years remarkable changes have taken place, which have been described elsewhere (Diver, 1933; see also Diver, C. & P., 1933). The survey area is about two miles long and comprises some 750 acres. The geological structure is simple. The comparatively narrow strip of old land on the western side is composed of the sand, clay, and gravel of the Bagshot beds, while all the rest is recent blown sand.

A trial survey of the Orthoptera was made in 1931 for the northern part of the present area (Diver, C. & P., 1933); and for this purpose the area was divided into squares by means of an *ad hoc* grid. This method, though having the advantage of giving units of equal area which could be roughly classified in terms of the few major vegetational types, has the disadvantage that these units are completely arbitrary and bear no relationship to the finer structure of the plant-carpet. For rapid surveys where time cannot be given to a detailed analysis of the habitats, the grid method, or modifications of it, has its uses; but at South Haven it was abandoned as soon as work on the full survey began and was replaced by the division of the area into 'locus-habitats'.

The term 'locus-habitat' is here used to denote a place characterized by a more or less uniform set of conditions. Within such a unit several separable sets of conditions are usually represented, but they are only treated as a single biotic complex if they are so distributed as to form a relatively fine mosaic throughout which they freely interact.

For instance, along the east coast of the peninsula there is a wide sandy beach backed by marram dunes. This line of beach and dunes extends for about 2800 yards. The dunes form one major locus called 'First Ridge'; but this is easily divisible by recognizable features into three sections, North, Central, and South, which correspond with differences in their physiographical development. These divisions are rationally transferred to the beach from which the growing dunes rise. Though there are other facts that lead to the further subdivision of both First Ridge and the eastern sea-beach, they will be neglected in this example for the sake of simplicity; and we can say that there are three beach loci, Sea-Beach N, C, and S. The conditions obtaining on the beach are specialized but simple; even so, three types of habitat can be recognized: first, the bare sand devoid of any plant cover; secondly, an occasional broken line of strand plants—*Cakile maritima*, *Salsola Kali*, and a small tuft or two of *Psamma arenaria*; thirdly, the wrack-line. The second condition is found only, for reasons given elsewhere (Good, 1935), in the south-central and southern sections. The play of physiographical factors differentiates particularly the

southern and northern expressions of the first and third habitat types. In this example, then, there are eight locus-habitats: Sea-Beach N, bare sand; Sea-Beach N, wrack-line; Sea-Beach C, bare sand; Sea-Beach C, strand plants; Sea-Beach C, wrack-line; and similarly for Sea-Beach S.

The sea-face line of First Ridge dunes is simpler than the beach in the sense that it provides only one type of habitat; but this habitat is a fine mosaic of at least two markedly different sets of conditions. Dense tufts of *Psamma*, with some *Festuca* of the *rubra* group, are more or less uniformly scattered over the mobile sand. In such a community it is obvious that a large proportion of the ground-surface is bare sand which, if taken as a whole and without reference to physiographical differences, might be thought comparable to the bare sand habitat of the beach. But, though there are variations in the density of the dispersal of the *Psamma* tufts, there is no single area of sand so free from their direct influences that it could properly be considered as a separate bare sand habitat. It is true that conditions on the beach sand are also influenced by the fact that it is backed by marram dunes and not by some other formation, and that this influence reaches its maximum at the junction of the two zones; but the ecological situation produced here is very different from that in the mosaic of *Psamma* tufts and bare sand patches where these two sets of conditions interact so extensively as to create one biotic complex.

A finer division would show, what is indeed obvious, that within, say, 'First Ridge N, sea-face *Psamma*' there are sub-habitats which would not be included in such a classified list of locus-habitats but would certainly be considered in the autecological studies of the species concerned, and might, in certain circumstances, even be treated synecologically. This point may be illustrated from two distinct angles. First, there are sporadically scattered through the dunes bits of wood and human debris which at least temporarily introduce both new food-material and different types of cover (a permanent wooden structure or a regular rubbish-tip would be treated as a locus-habitat). Secondly, there are the parasitic organisms. Taking the term broadly, these display many different types of behaviour. Some pass so much of their existence entirely within the living tissue of another organism that for practical purposes their host is their habitat. Not far removed from these are the social parasites and guests that live in the nests of social Hymenoptera (for the species so connected with British ants, see Donisthorpe, 1927). Others have a less intimate or shorter connection with their hosts and may grade into simple predators. But, in spite of the special problems that such organisms present, the general

methods here outlined are applicable. The distribution of a parasite is seldom co-equal with that of its host, and the habitat in which the host lives has at least an indirect effect upon the parasite.

Following the principles outlined above, a general conspectus of the peninsula shows that, though it may loosely be described as a heath, several distinct types of country are recognizable: sandy beach, marram dunes, dry and damp heaths, the harbour shore and various saltings, freshwater marshes and swamps, Little Sea and smaller freshwater pools, scrub and woodland, grass and turf, and recently disturbed areas. These general types, considered in reference to their physiography, history, and geological basis, form the natural major units or loci. Within these major divisions there are about 100 different types of habitat; and in the preliminary work some 700 locus-habitats were determined. The more detailed study of the plant-carpet during the last three years, our increasing knowledge of the distribution of animal groups, and the results of several extensive fires have led to a great increase in this number. When the new list, which will be completed this summer and which provides the basic classification for our work, is compiled, it will contain between 1700 and 2000 loci—each an entity, often discrete, comprising a particular habitat with reasonably sharp boundaries recognizable in the field.

In spite of the fact that, for general convenience in mapping distributions (Diver & Good, 1934), advantage is taken of every permanent feature (such as gullies, paths, and banks) by which a large uniform area can be broken up into sub-loci, the final units must inevitably show a great range in size. In some places almost identical conditions stretch continuously over many acres and form a single locus incapable of natural subdivision; while small pond-holes, which must be separately differentiated, may occupy only a few square feet. At first sight this might seem a drawback to the method; but, as will appear later, it in no way invalidates the general conclusions we seek to draw, and in fact opens the data to examination along new lines.

Though it can hardly be said that any two loci are completely identical as habitats, their classification into even the finer habitat types presents few difficulties; and a general classification into main types produces groups many of which contain large numbers of comparable loci. An example may be given from the survey of the ants, now being carried out by Miss Carey and myself in the light of the recent most detailed subdivision. This survey is not yet complete, but so far 985 locus-habitats have been examined. Of these 202 fall under the general heading 'dry heath', which is

divided into seven habitat-types, and 142 under 'damp heath', which includes five types. Some of these loci are contiguous subdivisions of large more or less continuous areas, others are small discrete units. The habitat-types used in this classification and the loci included in them will naturally differ slightly with the varying importance of particular attributes to the group of organisms under consideration. It is, therefore, essential, if the locus-habitat is to be used as a general unit for all groups of organisms, that its uniformity must be considered in respect of all major attributes.

THE ROLE OF THE PLANT-CARPET IN DETERMINING THE ATTRIBUTES OF A HABITAT.

From the point of view of an animal each habitat must be considered from several angles, of which the three following are the most salient: the suitability and sufficiency of the food; the nature of the protection or cover afforded during resting periods; and the provision of satisfactory conditions for mating, breeding, and the free expression of other habits.

Since plants are the primary link in any food-chain, a habitat must first be considered in respect of the opportunities it affords for their development. Its nature cannot be fully known until all the plant-species present have been listed and the relative frequency, at least of the principal species, roughly determined. Variations in the degree of dominance displayed by particular species have marked effects either by eliminating or letting in other species which, though botanically less prominent and perhaps unimportant, may be of vital interest to particular species of animals. Lists of vascular plants have now been made for all the principal and most of the fine locus-habitats on the peninsula.

The other attributes of a habitat may best be illustrated by a few simple examples. In the dune succession behind the eastern sea-beach Good (1935) recognized three major plant zones: dune-grass, dune-heath, and dry heath. Botanically, this statement is probably sufficient; but zoologically at least five zones (which were indicated by Good, but subordinated in his classification) must be recognized. These are best differentiated in the northern section. First, there is the sea-face *Psamma* which has already been considered above. This is followed by what we have called the *Leontodon-Jasione* zone, where these low plants together with others such as *Carex arenaria*, *Filago minima*, *Hypochaeris*, *Cerastium*, and a few more join the community. In the somewhat peculiar circumstances of South Haven, the next stage is not the formation of a closer turf-carpet, but the invasion of Ericoids and the production of dune-heath in which scattered tufts of *Calluna* and *Erica cinerea* are added

to the existing species. On the older slopes of First Ridge N that border 'Saltings Strip' the frequency of Ericoids increases. West of the Strip on the younger slopes of the older Second Ridge is a condition we call *Calluna-Psamma*. Here, there are well-developed clumps of *Calluna* and *Erica* with a good lichen-moss carpet between them. Some *Psamma* persists with, of course, *Carex arenaria*, but the other dune-plants, if present, are only very sparsely represented. On the older slopes of this ridge this community passes into almost pure *Calluna* giving 80-90 per cent. ground-cover.

The *Leontodon-Jasione* zone differs from the simple conditions of the sea-face *Psamma* in the following respects. The plant-species have increased from two or three to about twenty, though most of them are rather sparse. These additional plants form patches of low open turf between the *Psamma* tufts, and thus not only provide a new feature, but reduce the areas of bare sand and render this less mobile. In other words, both the variety of food and the amount of occupiable ground has been increased. The mosaic of tall and short vegetation which results is a condition of considerable ecological importance to animals and plants (cf. for grasshoppers, Diver, C. & P., 1933). The dense grass-tufts provide good resting cover within which movement except for quite small organisms is not easy and the adjacent turf-patches give open, sheltered areas for feeding, courtship, etc. As with the plants, there is a general increase in the number of animal species.

Dune-heath still possesses all these features but adds to them the new food-supply and the new type of much looser but excellent cover provided by the two Ericoids. The *Calluna-Psamma* zone is a simplification of these conditions. The number of effective plant-species decreases; and, though the Ericoid cover increases, the dense grass-tufts disappear. The amount of bare sand is still further reduced and the open mixed turf has been replaced by the closed almost uniform lichen-moss carpet. As this zone passes into the older heath the process of simplification continues. Apart from the dense and almost continuous *Calluna*, there is little but rather sparse *Erica cinerea* and *Carex arenaria*. This increased uniformity in conditions and the limitation of the number of food-plants impose their inevitable restrictions upon the animal community.

In this particular succession, then, dune-heath is the high point of varied habitability, dropping away to the simplified conditions of the pure *Psamma* on the one side and the pure *Calluna* on the other. Though this is true generally, it is not necessarily exemplified within particular groups of animals. Among the ants only two species can apparently

subsist in the pure *Psamma*. These are joined by four more in the *Leontodon* zone; but in dune-heath two of these drop out and only one comes in. *Calluna-Psamma* shows the expected further simplification; but in the large areas of older heath, though there is practically no occupation of the dense *Calluna*, more species, whose nesting sites are confined to the open interstices, are in fact recorded. The grass-moths of the family Crambidae are absent, or only very sparse in the *Psamma* and *Leontodon* zones. Five species are recorded from dune-heath; but only one really occupies the *Calluna-Psamma*, and none at all occur in *Calluna* heath. Only one species of wood-louse, *Porcellio scaber*, has been recorded for the first four zones. This species can live, but sparsely, within *Psamma* tufts, but apparently finds the conditions beneath an Ericoid clump far more comfortable. Under really dense continuous *Calluna*, which preserves a high degree of humidity at ground-level, at least two more species occur. The distribution of such small animals as the ants and wood-lice suggests that this type of *Calluna* canopy produces conditions approximating to those found in woodland.

Bracken provides an obvious example of the changes effected by the introduction of a single species to a community. As a potential source of food, *Pteris* is not a plant which directly interests many animals. At South Haven it may be associated with heath, grass, scrub, woodland, and even the fringes of, or slight rises in, marshland. On each of these major habitats it imposes different modifications and introduces conditions which will vary with the type of the habitat. In heath loci it never achieves the luxuriance of growth that may be found in a sheltered woodland glade; and, in consequence, the permanent dead-frond blanket, which is so characteristic a feature in the latter type of locus, plays a much reduced part. One of the main effects of this blanket is to preserve at ground-level an atmospheric humidity which may render an otherwise unsuitable habitat tolerable to certain species of Mollusca. To ants and wood-lice the conditions produced are not dissimilar to those beneath dense continuous *Calluna*, and the same species occur. The summer canopy of living fronds, though in both types of habitat it provides additional cover of a special kind, has other attractions peculiar to each type. In a sunny glade surrounded and sheltered by trees the surface of the canopy (and in spring that of the dead-frond blanket—much used by hunting spiders) offers good perching and sunning sites to dragonflies (Libellulids, Agrionids), Syrphids (e.g. *Eristalis*, *Chilosia*), Muscids, and butterflies. For different purposes

it is freely visited by several species of aculeate Hymenoptera (*Vespa*, *Andrena*, etc.). On the open heath these surface-layers are exposed and do not offer the same amenities; but the edges of the bracken patch often provide a wall of shelter (for, e.g., Agrionids, *Syrphus*, etc.) which from the nature of the habitat is not displayed in a glade. It is an interesting feature in the distribution of the widely tolerant ant *Formica fusca* that, though it shows a marked preference for *Pteris* in other habitats, it seems to be entirely absent from that of the woodland glade.

In a similar way the vegetative habits of all the principal plants (*Molinia*, *Myrica*, *Phragmites*, *Sphagnum*, *Rubus*, *Ulex*, *Pinus*, *Salix*, *Betula*, to name only a few of the larger and more obvious ones) contribute their specific quota of influences which differ from habitat to habitat both because different conditions change their habit and because in different communities different attributes are expressed.

Some ecological advantages of a mixture of taller and shorter vegetation have already been mentioned; and these are further demonstrated in 'Juncus-turf', which is a relatively fine mosaic of *Juncus* tufts and a close carpet of low plants, or in 'Rubus-scrub' where the protection from grazing round the edges of the bushes gives rise to an important marginal zone between the *Rubus* and the surrounding short turf. Comparable effects on a larger scale may be seen in the coarse mosaic of willow-birch clumps scattered over marsh and heath, or inversely of open glades in woodland. The margins of these clumps present, as it were, a tall plant 'cliff' which is but an enlargement of the bracken wall already mentioned, and which every naturalist instinctively recognizes as a good hunting ground. On the leeward side of such a clump are excellent resting and basking sites well above ground-level which are used by many insects; the under sides of the leaves give cover and shade when required, and opportunity for predators (such as spiders) to lie in ambush. The larger dragonflies (*Aeschna mixta*, *Ae. juncea*, *Sympetrum striolatum*) that hawk over marsh and heath congregate in these places. In the woodland glade with its increased shelter and other additional attributes these amenities are enhanced; and in consequence the variety and volume of animal life also increases. Macan, working on the Corixidae (water-bugs), found that the submerged vertical faces presented at the edges of rafts of *Hypericum elodes* round the shores of Little Sea were an important habitat, particularly for the carnivorous *Cymatia*. These *Hypericum* 'cliffs' seem to be the analogue in the aquatic world to the clump border in the aerial.

THE APPLICATION OF THE 'LOCUS-HABITAT' METHOD
TO AUTECOLOGICAL STUDIES.

After detailed examination in the light of these principles, the whole survey area is divided into biotic units, which are delimited primarily on the major physical factors and secondarily on the fine shades of difference in the plant-carpet in such a way that each unit, though variable in size, is reasonably uniform in respect of a number of known attributes. These units are thus susceptible both of a general classification based upon all their known attributes and of a specific arrangement in terms of any particular attribute or set of attributes. If the distribution of an organism is known in terms of these units, it is possible, within the limits of the habitats represented in the area, not only to measure its general range of tolerance but to determine by analysis which of the major attributes exercises most control over its range.

The distributional data for a particular group of species are collected by the simple but laborious method of examining every unit and recording the species present. These records are first entered, species by species, on separate maps so that their geographical relations can be seen at a glance; and are then tabulated on a classified locus-habitat list, from which it can be determined what proportion of any group of units are occupied by each species. A simplified example may be given. The yellow ant, *Lasius flavus*, finds its optimum in turf, occupying 50 per cent. of the 135 loci so far examined; in the salt-marsh group, taken generally, it is present in 20 per cent. of the loci with, as would be expected, a heavy concentration in *Juncus*-turf: it is absent from woodland. On the other hand, *Myrmica ruginodis* has its optimum in woodland with about 30 per cent. occupation, is only present in 4 per cent. of the turf loci, and is altogether absent from salt-marsh. Corresponding figures have been worked out for such increasingly mobile groups as the grass-moths (Crambidae) and dragonflies. The number of locus-habitats is sufficiently large in relation to the number of habitat-types to allow of statistical treatment on the basis of a much finer classification than is indicated in this example.

When discrete habitats of the same general type are frequently repeated, but with classifiable differences, as in the case of the 40 odd willow-birch clumps, the damp dips of which there are about 100 in the blown-sand ridges, or the 70 shallow artificial 'pans' on the Bagshots, it is possible to arrange them in a series in respect, for instance, of increasing wetness, and thus to see at about what stage in this progression any particular species drops out or comes in. The plant-carpet supplies essential evidence for the proper arrangement of such a series. The simplest case is that of the dips. At the

drier end are those that are practically never flooded but are merely differentiated from the surrounding heath by the fact that *Erica Tetralix* replaces *E. cinerea*; at the next stage *Molinia* enters to become a co-dominant with the Ericoids; from this the series continues to those dips that are usually flooded for several months in the year and are characterized by *Molinia*, *Myrica*, *Junci*, and *Eleocharis multicaulis*; the end term is an isolated pool. Of those examined for ants, *Lasius niger* was found in 24 per cent. of the *E. Tetralix* dips, but was absent from all the real *Molinia-Myrica* dips, though it occurred in one that is intermediate between these two types.

It must be noted that this method takes no account of population density, and is in fact independent of it. It measures the 'popularity' of a habitat by the number of times loci showing certain defined characteristics are found to be occupied. The measurement of density is a separate problem requiring its own technique; but if suitable methods are used the data can readily be incorporated as a valuable extension of the locus-habitat method.

In the analysis of the data certain facts must be taken into consideration: the rareness and geographical dispersal of the loci within a habitat group in relation to the dispersal of the organism; the individual peculiarities of loci which may render them just habitable while others within the same group remain unoccupied; the effect of juxtaposition with other types of habitat; and variation in the size of the loci. This latter variability permits consideration of the important question: what are the lower size limits at which effective occupation of a discrete habitat remains possible for different organisms?

Owing to the marked conservatism that characterizes the behaviour of most animals, this method can satisfactorily be applied even to the most mobile; but obviously the size of the organism must be taken into account. The very fine subdivision possible in the case of a wood-louse may be meaningless to a large mammal or bird. The data for organisms with complex life-histories or habits must be carefully collected. It should be recorded for each locus whether it was occupied as the site of a burrow or nest, for feeding, or for mere passage. With a holometabolous insect all three phases of development must be considered. Insects having aquatic nymphs and aerial imagines require two distinct surveys.

No more has been attempted here than a brief summary; but certain conclusions are clear. In ecology the division between botanist and zoologist loses its meaning. A habitat

can only be considered as a single biotic complex in relation to physical conditions. The plant-carpet, if studied in sufficient detail, provides a valuable first approximation in the classification of habitats; and this classification can be applied to measuring one of the most important reactions of an organism—its range of tolerance, or degree of adaptability to the environment.

I am much indebted to the Trustees of the Leverhulme Research Fellowships Fund for a grant, which has greatly facilitated the progress of this work.

LITERATURE CITED.

- DIVER, C. 1933. The Physiography of South Haven Peninsula, Studland Heath, Dorset. *Geogr. Journ.*, LXXXI, pp. 404-27.
- , C. & P. 1933. Contributions towards a Survey of the Plants and Animals of South Haven Peninsula, Studland Heath, Dorset.—III. Orthoptera. *Journ. Anim. Ecol.*, II, pp. 36-69.
- , C., & GOOD, R. D'O. 1934. Contributions, etc.—IV. General Scheme of the Survey. *Journ. Anim. Ecol.*, III, pp. 129-32.
- DONISTHORPE, H. ST. J. K. 1927. The Guests of British Ants. London.
- GOOD, R. D'O. 1935. Contributions, etc.—II. General Ecology of Flowering Plants and Ferns. *Journ. Ecol.*, XXIII, pp. 362-405.

PROCEEDINGS OF THE GENERAL MEETING

7 April 1938

Mr. J. RAMSBOTTOM, O.B.E., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 17 March 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Rose Bracher, Alice Jane Davey, John Laker Harley, Albert Henry Beaumont Kirkman, Edmund William Yemm, and Cecil Terence Ingold.

Certificates of recommendation of the following candidates for Fellowship were read:—For the first time, in favour of Winifred Margaret Warden, Hamilton Blackiston, and George Philip Wells.

A certificate of recommendation of the following candidate for Foreign Membership was read for the first time :—Carl Jörgen Wesenberg-Lund.

A certificate of recommendation of the following candidate for Associateship was read for the first time :—Charles Edward Britton.

The President announced that the Council had resolved unanimously to award the Linnean Gold Medal for 1938 to Sir D'Arcy Wentworth Thompson, C.B., F.R.S.

In accordance with Chap. X, Sect. VII of the Bye-Laws, the following Fellows were elected, by show of hands, as Auditors of the Treasurer's accounts for 1937-38 :—

Representing the Council : Dr. B. Barnes.

Mr. D. J. Scourfield, I.S.O.

Representing the Fellows : Mr. R. H. Burne.

Dr. T. A. Sprague.

The President reported the death of Mr. Stanley Edwards, Fellow of the Society.

The President expressed a hope that Fellows resident in or near London would offer hospitality to the Society's Visitors to the 150th Anniversary Celebrations ; and added that it would be convenient if such offers were made as soon as possible. The Officers will shortly be sending to Fellows resident in or near London a list of Foreign Members and Delegates, British and foreign, who are expected.

Mr. E. R. GUNTHER, F.L.S., gave an account, illustrated with diagrams and lantern-slides, of 'Living Fin Whales and inferences from their swimming movements'.

A discussion followed, in which Dr. F. D. Ommañney (Visitor), Mr. A. H. Laurie (Visitor), and Dr. F. C. Fraser (Visitor) took part ; Mr. Gunther replying.

Abstract.—

The observations collected into this paper were made by the author while engaged on whale-marking experiments on behalf of the Discovery Committee in the sub-Antarctic whaling grounds of South Georgia. The movements of whales as they break surface to breathe were described and were illustrated by a series of lantern-slides. From these data and correlated facts, the actions of the whale beneath the surface were inferred. Possible interpretations of their significance were made from a consideration of the shape of the whale. It is hoped to publish the results at a later date.

Discussion.—

Dr. F. D. OMMANNEY, after congratulating the lecturer, made some remarks on the 'slik'—the oily patch of water which appears at the surface after the whale has dived. He said he agreed with Mr. Gunther's opinion that the 'slik' is probably an upwelling of water caused by the upthrust of the tail-flukes. This upward stroke of the tail, which gives the whale his purchase on the water and the necessary push-off at the beginning of his dive, often results in the tail-flukes being raised clear out of the water. This is frequently seen in Humpback whales and very occasionally in Fin whales. The speaker thought that the 'slik' was usually absent when this occurred. He also mentioned the asymmetrical colouring of Fin whales and suggested that this might perhaps be of significance in connexion with the rolling movements which Mr. Gunther had observed in a school of Fin whales which were feeding.

In reply Mr. GUNTHER said that, as far as his observations went, Fin Whales rolled on to their left sides as often as on to their right, and that he himself had been unable to find evidence for linking the asymmetrical pigmentation with this habit, though the idea was an attractive one. He added that he had not stressed the extraordinary degree of variability shown even by one species of whale in its habits and movements. He had purposely omitted reference to other species of which he had little direct knowledge, but he found himself in agreement with the points suggested by Dr. Ommaney. Concluding, he pointed out difficulties in observing whales, and emphasized the desirability of independent records from observers of scientific standing.

Mr. NORMAN WOODHEAD, F.L.S., read a paper, 'Algal cultures from the silt of Llyn Maelog'. [Published in full below, p. 139.]

Dr. B. P. UVAROV, F.L.S., gave an account of his paper, 'Some Acrididae from south-eastern Tibet'—an account of grasshoppers collected by Mr. R. J. H. Kaulbeck and Mr. J. Hanbury-Tracy, including fourteen new species. [The paper will be published in the Journal.]

Mr. CECIL H. HOOPER, F.L.S., gave an account, illustrated with lantern-slides and specimens, of 'The pollination of British fruit trees and bushes'.

Abstract.—

Commencing with the well-known fact that the apple, pear, plum, and cherry are more or less self-sterile—the degree varying with the race and in some approaching 100 per cent.—he stressed the need of visits from insects to the flowers

Insects observed in the flowers of fruit-trees at Wye, Kent.

Fruit-tree.	Hive bees.	Bumble bees.	Smaller wild bees.	Blue-bottle flies.	Other flies.	Beetles.	Wasps.	Butterflies.	Ants.	Thrips.	Aphides.	Earwigs.	Other insects.	Period when flowers occur.
Almond	6	1	..	..	..	1	..	..	..	..	..	..	..	2. iii.-11. iv.
Peach	37	7	..	2	..	..	..	..	2	..	..	..	..	14. iii.-29. iv.
Pear	252	19	15	19	39	..	4	1	..	..	..	..	2	21. iii.-29. iv.
Plum	55	34	36	2	15	..	..	1	..	..	..	..	..	21. iii.-8. v.
Gooseberry	73	29	2	4	..	..	..	..	..	..	..	..	..	24. iv.-4. v.
Red Currant	10	1	2	..	1	..	..	..	..	..	..	..	..	20. iii.-29. iv.
Black Currant	55	18	16	..	..	..	..	..	..	..	..	..	1	30. iii.-30. iv.
Cherry	106	92	8	..	..	..	..	..	..	..	..	..	1*	30. iii.-29. v.
Apple †	479	54	23	..	27	104	..	..	51	2	..	3	..	19. iv.-2. vi.
Raspberry §	797	32	32	..	24	..	..	..	..	..	..	..	..	21. v.-31. vi.
Quince	8	1	..	..	4	..	..	..	..	..	..	..	..	1. v.-10. vi.
Loganberry §	1272	62	62	..	79	..	..	..	..	..	..	..	..	19. v.-30. v.
Blackberry	105	106	1	..	4	..	..	9	..	..	..	..	..	21. vii.-28. viii.

* A spider.

† Among the beetles, 14 weevils.

§ Observations by Mr. H. C. Chapelow.

to ensure fertility, and then discussed the efficiency of the spring insects as carriers of pollen. No insect is more effective than the hive-bee, which visits the flowers of all the British fruit-trees with diligence and a great constancy; and it may be disadvantageous to cultivate fruit-trees where no hives are kept.

Some apple trees scarcely fruit if insects be experimentally excluded.

No variety of pear is very self-fruitful, though some are much more self-fruitful than others.

Plums vary greatly as to self-fruitfulness or self-unfruitfulness. A certain number are very self-fruitful, one or two varieties even mature a little fruit when apparently unpollinated. Many varieties are somewhat self-fruitful, but crop better with pollen of another variety, whereas some never produce fruit with their own pollen.

As to cherries, the sweet varieties are self-unfruitful or practically so, sour cherries are slightly self-fruitful but crop far better with another variety—Morello, however, is perfectly self-fruitful, and even matures a little fruit when insects are excluded.

Peaches are most of them self-fruitful, but need insects or hand-pollination to carry the pollen.

The strawberry is partly fertilized by the wind, partly by insects. In glass-houses wind through the ventilators must distribute pollen.

Insect surveys of different districts may be of great interest and even of economic value. Naturalists agree that the members of the bee family are the best pollenizers, hover and drone flies probably take the second place. Beetles visit fruit blossoms for sinister reasons, usually partially or totally destroying the flowers. Butterflies and moths are of little account in the pollination of fruit trees.

The table on p. 138 indicates the nature of the insect population attracted to the flowers at Wye, from data collected from 1912.

ALGAL CULTURES FROM LLYN MAELOG, ANGLESEY.

BY N. WOODHEAD, M.Sc., F.L.S., Department of Botany,
University College of North Wales, Bangor.

THE algal flora of Llyn Maeiog, Anglesey, has been examined for a period of over four years from plankton and other samples, taken at daily intervals. In a previous paper (Woodhead, 1937) 204 species were recorded, of which 84 are diatoms, 80 Chlorophyceae, and 33 Myxophyceae: among these a few species are present in large numbers during various seasons of the year.

In 1930 the lake became the water-supply reservoir for the neighbouring village of Rhosneigr, and in each year the water, as supplied to the consumers, has been seriously affected by summer and autumnal water-blooms which produce strong and unpleasant smells and tastes. Even after mechanical and chemical treatments have been applied the water has remained discoloured as well as disagreeable to smell and taste. The algae in the lake include a number of species, among those abundant, that are known elsewhere to produce such obnoxious effects. These are principally Myxophyceae, eight species of which have been found commonly in the summer planktons.

The recognition of the seasonal cycles led naturally to a consideration of the status of the organisms in the resting periods when they were absent from the surface hauls. The incoming water flowing into the lake has a negligible effect as far as the introduction of algae is concerned. Each fresh dominant organism must be present in some form in the silts comprising the lake-bed, which must also contain a high percentage of dead or decaying organisms, as well as the series of forms recorded as characteristic of the silt itself. This latter group of organisms had been detected as including the species which were noted sporadically after heavy gales when the layers of the lake had been thoroughly stirred up: such 'bottom organisms' settled rapidly.

The practical considerations which led to the initiation of the present series of investigations made it desirable that information be obtained about the factors determining the seasonal rise (vertically) of the organisms that had been shown to be obnoxious. If, in some measure, summer conditions could be induced in winter months, then a comparative study of the floras might lead to some control of the harmful species. Of the factors that were implied in such a seasonal difference the intensity and daily duration of illumination at the bed of the lake and the temperature of the water lent themselves most readily for study, as specially built light-chambers were available in the laboratory.

Each unit consists of an asbestos-walled chamber in which temporary staging permits some flexibility of arranging material at varying distances up to the source of light. The roof of the unit is a large glass-bottomed water-screen fitted with inlet and outlet, allowing regulation of the flow of cold tap-water and of the depth of the water-screen. The supporting walls of this screen are copper. Illumination is obtained by means of a 500 c.p. Osram lamp and reflector, the period of illumination being controlled by time-switches.

The first series of experiments were exposed to daily periods of eight hours' illumination, but all later series were given 12 hours' illumination, except as otherwise stated.

Samples of the silt were dredged from the lake-bed and placed in museum-jars, a large volume of lake-water being added. Such 'cultures' require occasional replenishment. The cultures are stirred about at intervals; and it has only rarely happened that bacterial contamination has been noticed.

It will be observed that the silt receives illumination through the superimposed water-layers, amounting to about 20 cm., together with some reflected from the inner walls of the chamber. The rise in temperature due to the heating from the lamp can be controlled by regulating the flow of water through the screen, and, during the period of illumination, the temperature of the liquids in the culture vessels varies between 18.5° and 21.5° C. : as the battery of three units is installed in a room with uniform minimum temperature of 9.0°–10.0° C. the range of temperature is comparable with a warm summer.

	December 6. Original silt.	December 31. Fourth week.
<i>Scenedesmus bijugatus</i>	f	f
<i>S. quadricaudus</i>	f	f
<i>Kirchneriella obesa</i>	+	—
<i>Tetraedron</i> sp.	+	—
<i>Tribonema minus</i>	f	o
<i>Cosmarium</i> sp.	—	vr
<i>Diatoma elongatum</i>	+	o
<i>Fragilaria</i> sp.	+	o
<i>Synedra ulna</i>	+	+
<i>Asterionella gracillima</i>	+	—
<i>Navicula</i> spp.	va	o
<i>Amphora ovalis</i>	+	+
<i>Gyrosigma</i> sp.	o	f
<i>Surirella biseriata</i>	+	+
<i>Aphanocapsa Grevillei</i>	vr	+
<i>Microcystis aeruginosa</i>	+	vr
<i>M. flos-aquae</i>	+	—

In the table the following abbreviations have been employed to denote the relative frequencies:—va, very abundant; f, frequent; o, occasional; vr, very rare; +, present, only one or two individual plants seen in the mounts made; —, absent from the mounts made.

Altogether fourteen silt samples, collected at different seasons from various parts of the lake, have been examined, the first culture being made on silts obtained from the lake-floor in December 1933: the lake-water temperature had been at about 4° C. for a fortnight and actually the surface was frozen over when the sample was taken. The original silt-flora was markedly diatomaceous with a far wider range of species than had been recorded in the plankton hauls even after stormy days. Similarly, *Scenedesmus* spp., *Kirchneriella obesa*, and *Tetraedron* were more abundant than

had been seen in surface-hauls. After a fortnight to a month of culture a flora had developed in the surface-layers which was non-diatomaceous in constitution and closely resembled some of the water-bloom mixtures with *Tribonema* that had been recorded for the lake at the end of the preceding summer. At the same time the diatom abundance had altered in the silts: the number of living species had diminished, but the survivors, even if less in quantity, were markedly healthy with active movement and good pigmentation.

A general similarity in the sequence of algae obtained by this method has been noticed. The natural silt-flora, mainly of diatoms, rapidly produces a vigorous development of *Scenedesmus bijugatus*, *Sc. quadricaudus*, *Pediastrum Boryanum*, and often *P. duplex*, associated with *Tribonema minus*, and in which many diatom species are subordinate. Unicellular and colonial green algae occur, and *Nitella flexilis* grows freely. This phase has no parallel in the plankton observations. It is followed by a phase of filamentous algae (e.g. *Bulbochaete*, *Tribonema*, *Stigeoclonium*) together with a luxuriant growth of *Nitella* which may attain a reproductive condition. This in turn gives place to a phase of Myxophyceae and finally an old culture-phase, in which living algae are relatively few and diatoms constitute the principal constituents. The onset of this phase has been noticed to occur after ten or twelve weeks of exposure to controlled illumination.

In January 1936 a silt sample was divided into three portions, of which P was exposed in the light-chamber, receiving twelve hours' illumination with an average temperature of 21° C.; Q was kept over a warm radiator in the laboratory, receiving oblique illumination from a north window and with an average temperature of 15° C., and R was kept in a cool glass-house at an average temperature of 7° C. In addition to the usual silt 'bottom organisms', short filaments of *Tribonema* were common. The culture P in the light-chamber followed the general scheme outlined above. *Bulbochaete* sp. was the principal filamentous alga in the second phase during which *Tribonema* had decreased. Before the Myxophycean flora developed, *Coleochaete scutata* colonies were abundant. *Anabaena* species then became frequent, rapidly multiplying to form a delicate mat in the water-layers. An unexpected blue-green associate also developed, *Aphanizomenon flos-aquae*, a species that has not yet been recorded from the lake samples over the whole period of observation. It became established as a dominant species in the culture together with *Anabaena affinis*.

Q, however, showed a decrease in abundance from its original flora, and the *Scenedesmus-Pediastrum* phase was

only induced when, after three weeks, the vessel was moved into the light chamber alongside P. The third culture, R, showed little difference from the original sample save for a decrease in *Tribonema*.

Naviculoid diatoms flourished in the cold dull conditions (R), but were adversely affected by warmth (P & Q). *Tribonema* diminished considerably in cold dull conditions, but survived until the development of sturdier filamentous algae in other conditions. The *Scenedesmus-Pediastrum* phase was only entered upon after a short exposure, of about a week's duration, to the warm illuminated conditions.

To judge from the range of observations listed during the routine plankton sampling (Woodhead, 1937) spores and resting stages of algae must be widespread in the silts. Although the Myxophyceae form such a striking phase in the algal seasonal cycles of the lake, yet they are seldom recognized in the silts themselves; for some of the principal species resting forms and spores are unknown to algologists. Yet these experiments, and studies of the literature, suggest that they exist in the lake in some quiescent condition for years before the suitable conditions arise for them to spring into prominence. In this respect the occurrence of *Aphanizomenon flos-aquae*, a species with spores, in the later culture experiments is important; unrecorded for the lake plankton and natural silts, its potentialities as a water-bloom producing organism would have been unsuspected. Bristol (1919) observes that resting-spores (akinetes) of *Anabaena*, a closely related genus, are capable of germination after fifty years.

The Myxophyceae have only occurred in large numbers from the silt samples, when the culture has been maintained for some considerable period, suggesting that the conditions for their success require long spells of bright light with a relatively high temperature. It is conceivable that their abundance follows a long spell of exposure to such conditions, rather than being conditional upon an optimum temperature or an optimum light-intensity. Once established, conditions in the light-chamber enable a water-bloom to persist for weeks, although in the lake itself, in spite of a continuance of warmth and sunshine, the water-bloom may vanish.

Some organisms do not tolerate the culture conditions—of these, *Asterionella gracillima* and *Dinobryon Sertularia* are among the main dominants in the normal lake seasonal cycles, but in culture the former rapidly dies out and the second is unrecorded. In the case of *Asterionella* the normal maxima occur at low temperatures and in low light intensities (mid-winter) so that its absence is not surprising. Other diatoms, e.g. *Amphora ovalis*, *Epithemia zebra*, *Eunotia* spp., thrive under culture and are conspicuous on account of their

bright colour and vigorous movements. For *Dinobryon* the temperature of the culture is slightly high, and it is more probable that the richness of the algal species and their high frequency prevent its successful establishment in culture: when it is abundant and dominant in the lake it has few associates.

BIBLIOGRAPHY.

- BRISTOL, B. M. 1919. On the retention of vitality by algae from old stored soils. *New Phytol.* XVIII, pp. 92-107.
WOODHEAD, N. 1937. Studies in the Flora of Anglesey and Caernarvonshire Lakes, I; The Algal Flora of Llyn Maelog, Anglesey. *North-Western Naturalist*, pp. 160-71.

PROCEEDINGS OF THE GENERAL MEETING

21 April 1938

Mr. J. RAMSBOTTOM, O.B.E., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 17 March 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Winifred Margaret Warden, Hamilton Blackiston, and George Philip Wells.

A certificate of recommendation of the following candidate for Foreign Membership was read for the second time:—Carl Jörgen Wesenberg-Lund.

A certificate of recommendation of the following candidate for Associateship was read for the second time:—Charles Edward Britton.

Mr. E. M. MARSDEN-JONES, F.L.S., and Prof. F. E. WEISS, F.R.S., F.L.S., gave accounts of their paper, 'The essential differences between *Anagallis arvensis* Linn. and *A. foemina* Mill.' [Printed in full below, p. 146.]

Prof. R. R. Gates discussed certain points, and the authors replied.

Dr. F. C. FRASER gave an account of ' Vestigial teeth in the Narwhal '. [Printed in full below, p. 155.]

A discussion followed, in which Mr. R. H. Burne and Dr. W. T. Calman took part ; Dr. Fraser replying.

Dr. J. C. WILLIS, F.R.S., F.L.S., gave an account, illustrated with lantern-slides, ' Some conceptions about Geographical Distribution '. [Printed in full below, p. 162.]

Mr. J. L. CHAWORTH-MUSTERS, F.L.S., gave an account, illustrated with lantern-slides, of ' A collecting trip to the Atlas '.

Abstract.—

This collecting trip was undertaken in order to gain some knowledge of the mammal fauna of the High Atlas which has hitherto been almost a *terra incognita* to mammalogists. Unfortunately 1937 was a bad season, and owing to drought or some other cause few mammals were obtained. However, time was not wasted, and a study of the avifauna was made. The most interesting ornithological results were the rediscovery of *Rhodopechys sanguinea aliena*, the discovery of the Black Redstart as a breeding bird above 9,000 feet, and the securing of a specimen of the Alpine Accentor at over 11,000 feet, where it was probably breeding.

A stay of over three months was made at Taddert at about 6,000 feet altitude on the Marrakesh—Ouarzazat Road, and from this base many excursions were made into the surrounding country. Of special interest were the woods of *Quercus Ilex*, which consisted of very old trees, with little new growth owing to the destructive influence of goats and man, an influence which the French authorities are doing their best to check. A great deal of time was spent on Jebel Bou Ourioul, where collections were made in the ' Alpine Zone ' between 8,000 and 12,000 feet. Slides were exhibited showing the various types of country visited.

Discussion.—

A discussion followed, in which Mr. W. S. Rowntree, Dr. G. P. Bidder, Prof. F. E. Weiss, Mr. M. A. C. Hinton, and the President took part, Mr. ROWNTREE remarking that the presence of nesting swallows at an altitude of 10,000 feet seemed to imply some abundance of flying-insect life at that altitude.

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THE ESSENTIAL DIFFERENCES BETWEEN ANAGALLIS ARVENSIS LINN. AND ANAGALLIS FOEMINA MILL. BY E. M. MARSDEN-JONES, F.L.S., and Prof. F. E. WEISS, F.R.S., F.L.S.

THERE still exists considerable confusion and uncertainty as to the status of the plant known as *Anagallis foemina* of Miller or *Anagallis coerulea* of Schreber owing to insufficient diagnoses given by these authors.

They have limited themselves to the following statements :—
Miller, 'Gardener's Dictionary', ed. 8, 1768 :—

Anagallis foemina : foliis indivisis glaucis, caule procumbente, flore coeruleo.

Schreber, J. C., 'Spicilegium Florae Lipsicae', 1771, p. 5 :—

Anagallis coerulea : caule procumbente foliis ovato-lanceolatis, corollis serratis, calycis foliolis subulatis.

Neither of them refers to the absence of glandular hairs on the margin of the petals, which has been taken as a diagnostic character by later systematists. On the other hand, Syme states in his 'English Botany' that blue-flowered plants are found both with and without gland-tipped hairs.

Owing to this uncertainty, it has seemed to us desirable to record the detailed morphological and genetical observations which we have made during the past few years, drawing special attention to the blue-flowered plants, of which we have been able to distinguish two distinct types, one of which is a colour-variety of *Anagallis arvensis* and the other a definite subspecies. We propose therefore to accept Schinz and Keller's subdivision of the species *Anagallis arvensis* into two subspecies :—

i. ssp. *phoenicea*, which includes the scarlet pimpernel and its various colour-varieties, one of them blue ;

ii. the ssp. *foemina*, which so far as our experience goes is always blue-flowered.

Our diagnostic description of the two subspecies is based on the examination of a considerable number of living plants, which we have been following through several generations. These have been collected from different parts of the British Isles and we still have them under cultivation. They will be dealt with under two headings, firstly *Anagallis arvensis* ssp. *phoenicea* and its colour-varieties and secondly, *Anagallis arvensis* ssp. *foemina*.

I. *ANAGALLIS ARVENSIS* Linn. subspecies *PHOENICEA* (Scop.)
Schinz & Keller (*A. phoenicea* Scop.).

While the usual colour of the corolla in this subspecies is scarlet, a number of colour-varieties have from time to time been recorded from the wild; and we have dealt genetically with those enumerated below. As there has been considerable difficulty and confusion as to the exact colour of the varieties so far described we are giving the names of the colours matched with Ridgway's Color Standards * :—

a. the common scarlet type (var. *phoenicea* Scop.) :
upper surface of corolla : *Grenadine*, pl. II of Ridgway ;
lower surface : *Grenadine Pink*, pl. II.

b. salmon or flesh (var. *carnea* Schrank) : both upper
and lower surfaces of corolla *Strawberry Pink*, pl. I.



FIG. 1.—The flower of *Anagallis arvensis* ssp. *phoenicea* and (fig. 2) the flower of ssp. *foemina* enlarged and seen from below. Calyces about same in size. Petals of 1 broad, slightly crenulate, and fringed with numerous glands. Petals of 2 shorter, narrower, denticulate, and with few glands.

c. pale or white (var. *pallida* Hook. f.) : upper and lower
surfaces of corolla *Cameo Pink*, pl. XXVI.

d. lilac (var. *lilacina* Alefeld) : upper surface of corolla
Vinaceous-Purple, pl. XLIV ; lower surface *Light Vinaceous-Purple*, pl. XLIV.

e. blue (var. *coerulea* Lüdi) : upper surface of corolla
Deep Cadet Blue, pl. XXI ; lower surface *Windsor Blue*,
pl. XXXV.

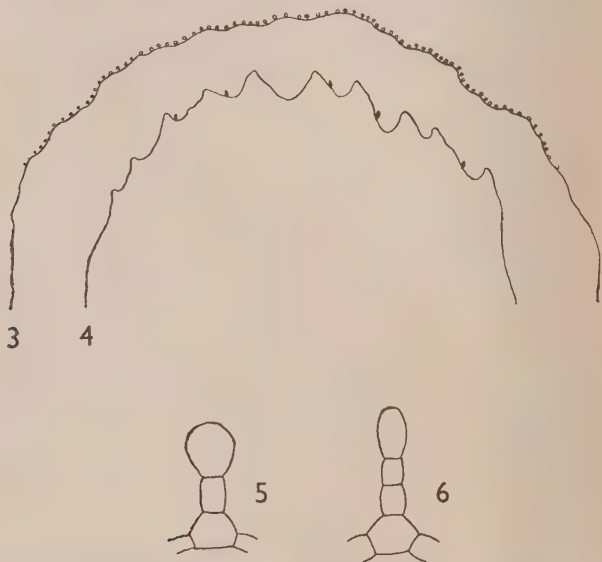
Though varying in the colour of their petals, they all have the same purple eye due to the cells of the throat of the corolla containing a purple sap in which small spicular blue crystals are aggregated in the centre. They all have a comparatively smooth outer margin (figs. 1 & 3) to their petals, fringed with numerous gland-tipped hairs which are always

* Ridgway, R. 1912. 'Color Standards and Color Nomenclature.' Washington, D.C.

composed of three cells including the basal epidermal cell (fig. 5). Occasionally the margin of the petals may be fimbriate, in which case the glands are less numerous.

The five colour-varieties enumerated above breed true for colour and for certain structural diagnostic characters, such as the number of cells in the marginal glands of the petals and in the staminal hairs.

When crossed in pairs in any combination they produce fertile seed in the first and subsequent generations. Scarlet is completely dominant to all the other colours in the F_1



Enlarged and diagrammatic drawing of the margins of the petals of (fig. 3) *Anagallis arvensis* ssp. *phoenicea* and (fig. 4) ssp. *foemina*. Petal glands of *Anagallis arvensis* (fig. 5) ssp. *phoenicea* and (fig. 6) ssp. *foemina*.

generation and the recessive colours segregate out usually in Mendelian ratios in the F_2 generation. This was pointed out by one of us in 1910*. The salmon colour is dominant to the pale. The blue is recessive to all the other colours, with one exception, namely when crossed with lilac there is segregation in the F_1 generation. Records of earlier observers who have crossed together the scarlet and blue colour varieties of

* Weiss, F. E. Rep. Brit. Assoc., Sheffield, 1910, pp. 779-80.

Anagallis arvensis ssp. *phoenicea* are generally in agreement with our results, but by some botanists the salmon-coloured variety (*carnea* of Schrank) has been regarded as the hybrid of *A. arvensis* var. *phoenicea* and var. *coerulea*. Hoffmann for example * states that he found this colour only occurring where red and blue varieties grew together both in cultivation and in the wild, and Pax and Knuth in Engler's *Pflanzenreich* give var. *carnea* Schrank as *Anagallis arvensis* var. *phoenicea* × var. *coerulea*. Most botanists, however, regard var. *carnea* as a colour-variety and Reichenbach † states definitely: "*A. carnea* Schrank, varietas e semine constans". With this we are, as stated above, in full agreement. Hegi ‡ also treats *carnea* as a colour-variety of *Anagallis arvensis* ssp. *phoenicea*.

We may add, however, that we have only found var. *carnea* in the wild growing in association with plants with scarlet flowers, from which it may have arisen by mutation.

The dominance of the scarlet colour over the blue was observed by Focke §. Crossing *A. arvensis* ssp. *phoenicea* ♀ with *coerulea* ♂, the latter having wide petals and many glands, he obtained a hybrid with scarlet flowers, though according to him slightly lighter in colour on the under surface. He obtained the same result in the case of the reciprocal cross. In both cases the resulting plants were completely fertile. In the F₂ generation he obtained a few plants with blue flowers, though most bore scarlet flowers. Probably these were in Mendelian ratios, though, as he was unaware of Mendel's work, he made no numerical counts. As stated above, we have generally obtained good Mendelian ratios in the second generation of the crosses between the colour-varieties of *Anagallis arvensis* ssp. *phoenicea* and so has Nilsson || between three of them.

The first flower of Focke's hybrid showed a segregation of colour, $\frac{1}{10}$ of the corolla being bright blue and $\frac{9}{10}$ scarlet, the later flowers were all scarlet. Dörfler ¶ also figures a parti-coloured flower found in the wild: and we have come across similar cases of segregation. An exceptional case of such colour segregation is the specimen of *Anagallis* exhibited by Miss Vachell ** at a meeting of the Linnean Society. On this plant four branches produced blue flowers, while the remaining seven branches bore pure scarlet flowers. The scarlet flowers had smooth margined petals fringed with

* Hoffman, H. 1879. Bot. Zeit. xxxvii, pp. 177-81.

† Reichenbach, J. 1831. Flora Germanica excursoria, p. 405.

‡ Hegi, G. 1906. 'Flora von Mitteleuropa', III, p. 1868.

§ Focke, W. O. 1887. 'Die Pflanzen-mischlinge', pp. 253 & 529.

|| Nilsson, Heribert, in Bot. Notiser, 1912, p. 229, and 'Hereditas', 1938, pp. 97-109.

¶ Dörfler, I. 1903. 'Herbarium Normale', no. 4484.

** Vachell, E. 1927. Proc. Linn. Soc. Lond. 1926-27, pp. 26-27.

numerous glandular hairs. The blue flowers had a denticulate margin with very few glandular hairs. A microscopic examination which we were allowed to make by the kind permission of Miss Vachell showed that the glandular hairs were of the same nature as those of the subspecies *phoenicea*, namely 3-celled *. Flowers with a denticulate margin to the petals and fewer glands have occasionally occurred in some of our plants of ssp. *phoenicea*.

After an examination of a considerable amount of British material of broad-leaved blue-flowered pimpernels, and an inspection of Linnaeus' type-specimen of *Anagallis latifolia* we have come to the conclusion that the Linnean specimen represents a particularly vigorous plant of the blue-flowered variety of *Anagallis arvensis* ssp. *phoenicea* such as we have ourselves observed.

II. *ANAGALLIS ARVENSIS* Linn. subspecies *FOEMINA* (Mill.) Schinz & Thellung (*A. foemina* Mill. ; *A. coerulea* Schreb.).

While this plant is recorded in the 11th edition of the *London Catalogue of British Plants* from 56 vice-counties, we believe that a number of these records may be erroneous and should refer to the blue variety of ssp. *phoenicea*. As far as we have been able to ascertain, the subspecies *foemina* is comparatively rare.

The colour of its flowers differs from that of the blue variety of ssp. *phoenicea*, being on the upper surface of the corolla *Grayish Violaceous Blue*, pl. XXII of Ridgway's *Color Standards*, on the lower surface *Ramier Blue*, pl. XLIII. The eye colour is the same as in ssp. *phoenicea*, but extends a little further upwards into the petals. The petals are usually narrower than in ssp. *phoenicea* with denticulate margin and sparsely glandular (figs. 2 & 4). The glands are composed of four cells, the terminal cell being elongate and not globular as in ssp. *phoenicea* (fig. 6).

We have been able to obtain seeds of this plant from two sources and the resulting plants were in agreement in all diagnostic characters and have bred true through many generations.

The ssp. *foemina* can be crossed with all colour varieties of the *phoenicea* group, but in each case, with the exception of the salmon variety, it produces only sterile plants in the F₁ generation †. While the scarlet colour is dominant when

* The difference in the number of the cells in the petal glands and in the staminal hairs of *Anagallis arvensis* and *A. foemina* (*coerulea*) was first pointed out and figured by Edwards, Journ. Bot. 1906, xxxv, pp. 368-70, and is a valuable diagnostic character (see figs. 5 & 6).

† Marsden-Jones, E. M. 1935. Proc. Linn. Soc. Lond. 1934-35, pp. 105-6.

ssp. *foemina* is crossed with the scarlet variety of ssp. *phoenicea*, it is slightly modified from the normal scarlet. Dörfler (loc. cit.) states that the flowers of the hybrid have a faint bluish tinge. This we did not observe in any of our crossings. When crossed with the salmon-coloured variety of ssp. *phoenicea* the resulting plants bore flowers which were on the upper surface *Chatenay Pink*, pl. XIII, on the lower surface *Livid Pink*, pl. XXVII, thus differing from the colour of the salmon parent. These plants were fertile and on selfing produced fertile offspring in the F₂ generation segregating for colour and other characters.

As the hybrid between ssp. *foemina* and the scarlet variety of ssp. *phoenicea* is always sterile, the various recorded instances of sterile hybrids between the blue and scarlet pimpernel probably represent this cross. This would include those described by Melsheimer* from Austria, by Becker† from the neighbourhood of Bonn, and by Dörfler from Würnitz in Austria. All of these were described as particularly vigorous plants with comparatively large flowers. In one flower Dörfler observed a parti-coloured petal, a blue segment appearing on the scarlet corolla. On the other hand, as Focke's crosses between blue and scarlet pimpernels were completely fertile and particularly as the petals of the blue flowers were broad and gland-tipped they obviously represented the two colour varieties of ssp. *phoenicea*.

We have observed certain dried specimens of completely sterile plants alleged to be crosses of *Anagallis coerulea* and *A. arvensis* (*phoenicea*). The specimens in question are in the Charles Bailey Herbarium in the University of Manchester. Two of these were collected by M. Schulze near Jena in 1884 and 1885 respectively. Two were distributed by Dr. C. Baenitz in his 'Herbarium Europaeum' as *Anagallis coerulea* × *arvensis*. They were collected by L. Geisenheyner near Kreuznach. A fifth specimen is in the series of Dörfler's 'Herbarium normale' (No. 4484) and is called *Anagallis Dörfleri* Rönninger in litt. (*Anagallis arvensis* × *coerulea*). It was collected near Würnitz in 1903 by M. and I. Dörfler. As all these specimens are distinctly sterile we are of the opinion that these alleged hybrids are all crosses between *A. arvensis* Linn. ssp. *phoenicea* and ssp. *foemina*.

On account of this genetical behaviour and of certain morphological differences we are of the opinion that *A. foemina* Mill. must be considered to be a subspecies of *A. arvensis*.

* Melsheimer. 1873. Verhandl. nat. Ver. d. preuss. Rheinl. xxx, p. 80.

† Becker, G. 1874. Verhandl. nat. Ver. d. preuss. Rheinl. Correspondenzblatt, p. 87.

*Tabular comparison between the ssp. phoenicea and ssp. foemina
of Anagallis arvensis.*

Subspecies *foemina*.

Subspecies *phoenicea*.

Leaves : lower ..	Broadly ovate.	Broadly ovate.
upper ..	Ovate or lanceolate.	Usually lanceolate.
Pedicels	Considerably exceeding length of leaf.	Usually not exceeding or only slightly exceeding length of leaf.
Calyx	Not covering petals completely in unopened flower.	Completely covering petals in unopened flower.
Corolla	Scarlet = <i>Grenadine</i> .	
	Salmon = <i>Strawberry Pink</i> .	
	Lilac = <i>Vinaceous Purple</i> .	
	Flesh = <i>Cameo Pink</i> .	
	Blue = <i>Deep Cadet Blue</i> .	Blue = <i>Grayish Violaceous Blue</i> .
Segments	Usually overlapping to about half their length.	Not overlapping.
Diameter	Up to 1.4 cm.	Up to 1.2 cm.
Petal length	Up to 7 mm.	Up to 6 mm.
Petal breadth	Up to 6 mm.	Up to 3.5 mm.
Petal shape	Broadly obovate.	Narrowly obovate.
Petal margin	Entire or obscurely crenulate on different plants.	Denticulate or crenulate on the same plant, and even on petals of the same corolla.
	Rarely denticulate or crenulate on the same plant.	
Glands	Very numerous, 3-celled.	Few, 4-celled.
Staminal hairs	5-8-celled.	11-12-celled.

The morphological differences are indicated in the following diagnostic description of the two plants:—

Anagallis arvensis Linn. subspecies *phoenicea* (Scop.) Schinz & Keller (*A. phoenicea* Scop.).

A straggling shallow-rooted annual or perennial with branched quadrangular stems, decumbent in large plants, erect or nearly so in small ones, up to 110 cm., clothed with scattered red-tipped glands. Lower leaves broadly ovate, up to 2.6×1.8 cm. Upper leaves ovate or lanceolate, up to 2.5×1.2 cm., margins scarious, minutely serrate, both surfaces sparingly glandular and under surface marked with purple spots. Leaves opposite, sessile. Flowers axillary. Pedicels slender, erect in flower, recurved in fruit, exceeding length of leaf, clothed with scattered red-tipped glands. Calyx segments narrow, lanceolate, apiculate, up to 5 mm. long, with membranaceous margin, not covering petals completely in unopened flower. Midrib slightly scarious, crenulate. Corolla rotate. Diameter of flower up to 1.4 cm. Free segments of the petal usually overlapping to about half their length. Colour usually scarlet, but sometimes salmon, flesh, blue, or lilac, in all cases with purple centre. Petals broadly obovate, up to 6 mm. broad. Petal-margins either entire or crenulate (fig. 1), rarely denticulate, densely fringed with gland-tipped hairs which are 3-celled including the basal epidermal cell. Stamens clothed at base with numerous purple hairs, 5-8-celled. Capsule spherical, 5 mm. in diameter, opening transversely, the upper part falling off. Seeds up to 45 per capsule, dark brown, trigono-hemispherical, 1×1.5 mm., papillose. Fl. vi to x.

Cross-pollinated occasionally by Hymenoptera and Diptera, adapted also to self-pollination and fully self-fertile.

Common. Native in gardens, arable fields, by road-sides, and on sand-dunes. Widely distributed in Britain except in the extreme North.

Anagallis arvensis Linn. subspecies *foemina* (Mill.) Schinz & Thellung (*A. foemina* Mill.; *A. coerulea* Schreb.).

A plant of similar habit to that of ssp. *phoenicea*. Stem up to 40 cm. Lower leaves broadly ovate up to 2.9×2.1 cm. Upper leaves usually lanceolate, up to $1.3 \times .5$ cm. Flowers as in ssp. *phoenicea*. Pedicels shorter than the leaves at flowering, clothed with scattered red-tipped glands. Calyx as in ssp. *phoenicea*, but completely covering petals in unopened flower. Corolla rotate, diameter of flower up to 1.2 cm. Free segments not overlapping exposing calyx segments (fig. 2). Colour blue. Petals narrowly obovate, up to 3 mm. broad. Petal-margins denticulate or crenulate,

ery sparingly fringed with gland-tipped hairs, which are 11-celled (fig. 6). Stamens clothed at base with numerous purple hairs which are 11-12-celled. Capsule as in ssp. *phoenicea*. Seeds up to 19 per capsule, shape as in ssp. *phoenicea* but with slightly larger papillae. Fl. vii-x.

Pollination as in ssp. *phoenicea*.

Rare. Native in arable fields usually in the southern and western districts of Britain.

CONCLUSIONS.

On account of the structural and genetical differences enumerated above we have come to the conclusion that *Anagallis foemina* Mill. must be considered a subspecies of *Anagallis arvensis*. By some botanists *A. foemina* has been given specific rank *, but as the differences mainly affect the corolla and some of these are of a quantitative nature and fluctuate to some extent, complete specific rank does not in our opinion seem desirable. On the other hand the difference in its genetic behaviour from that of the blue variety of the Scarlet Pimpernel would appear to raise it beyond the rank of a variety. Emphasis should also be laid on the importance of the difference in the number of cells in the staminal hairs and glands of the two subspecies as a diagnostic character, a character that so far as our experience goes does not fluctuate. We agree therefore in the division of the species *arvensis* into two subspecies *phoenicea* and *foemina* respectively, as is done by Schinz and Keller in their 'Flora of Switzerland', though they do not mention any blue variety as occurring in ssp. *phoenicea*. Hegi, on the other hand, who adopts this classification, indicates that ssp. *phoenicea* includes a blue colour variety in addition to the various shades of red and violet.

The main reason for the confusion which has arisen in the past and still continues to some extent, would appear to be due to the non-recognition by many botanists of the fact that there exist two distinct blue-flowered pimpernels, the one a mere colour variety of the Scarlet Pimpernel, the other a distinct subspecies, producing only sterile offspring when crossed with the scarlet, pale, or blue coloured varieties of ssp. *phoenicea*. These two blue-flowered plants, as is shown above, differ from each other both in their structure and in their genetic behaviour.

The research on which this paper is based has been aided by a Royal Society Government Grant.

* See, for example, Butcher, W. R., and Strudwick, F. E., 'Further Illustrations of British Plants'; Williams, F. N., 'Prodromus Florae Britannicae'; Hayward's 'Botanists' Pocket Book', and Druce, C., 'British Plant List'.

Discussion.—

Professor R. R. GATES said that it was interesting and surprising that the blue pimpnel was the bottom recessive in the colour series red, salmon, white, blue. In some other genera blue was the top dominant. It was rather a fine question whether the two forms of *Anagallis* were best regarded as subspecies or species. The sterility of the F_1 hybrids might seem to favour the latter view. A cytological investigation might also throw light on the cause of this sterility.

VESTIGIAL TEETH IN THE NARWHAL.

By F. C. FRASER, D.Sc., Department of Zoology,
British Museum (Natural History).

[Communicated by the ZOOLOGICAL SECRETARY.]

[PLATE 3]

THE existence of a second pair of teeth, in addition to the tusks, in the upper jaw of the Narwhal (*Monodon monoceros*) has been known for some considerable time, the original discovery being made by Cl. Mulder in 1835. Attention to these vestiges, with reference to Mulder's specimen, was drawn by Wiegmann in 1836, by Rapp in 1837, and by Van der Hoeven in 1858.

Gervais, writing in 1873 and describing a foetal specimen which he says was 'presque à terme' states: 'Outre ces deux dents qui répondent aux dents connues des narvals, j'en ai trouvé deux autres, une pour chaque côté, n'ayant que quelques millimètres de long et placées en dehors d'elles. Ces dents sont à peu près piriformes et elles ont déjà leur bulbe entièrement ossifié. Elles sont caduques et doivent disparaître de fort bonne heure'.

In the 'Ostéographie des Cétacés', 1880, of van Beneden and Gervais, the description of the same foetus is repeated almost verbatim and in the atlas there are several figures, (pl. XLV, figs. 1-4). It may be noted incidentally that the specimen which he describes as an almost full-term foetus is 3' 10 $\frac{1}{8}$ " (117 cm.) long, whereas Turner describes a foetus of 5' 5" (165 cm.), and there is in the British Museum collection an articulated skeleton of a foetus about 5' 2 $\frac{1}{2}$ " (158.8 cm.) long.

Van Beneden (1889), again refers to Gervais' foetal specimen, but neither author mentions Cl. Mulder's work on the subject of vestigial teeth.

Sir William Turner, writing in 1872 in the 'Journal of Anatomy and Physiology' (1872 *a*) and in the 'Proceedings of the Royal Society of Edinburgh' (1872 *b*), describes the

dissection of a $7\frac{1}{4}$ " (18.4 cm.) male Narwhal foetus, in the upper jaw of which he found that 'embedded in the gum on each side were two well-formed dental papillae, barely visible to the naked eye. Each papilla was contained in a well-defined tooth sac. Calcification of the papillae or of the wall of the tooth had not commenced. The minute structure of the embryonic teeth was next described. The more anterior of the two papillae was $2/10$ " (5 mm.) behind the tip of the jaw and the more posterior lay about $1/10$ " (2.5 mm.) behind the anterior'.

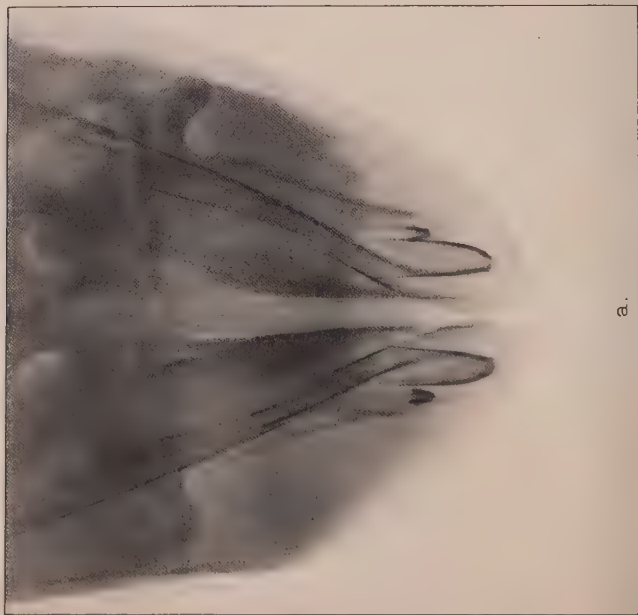
In 1878 Turner described a foetus 5' 5" (165 cm.) long: 'At the anterior end of each of these bones [the maxillae] were two well marked sockets, one opening immediately behind the other. The anterior socket contained a cylindri-form rudimentary tusk. The posterior socket contained



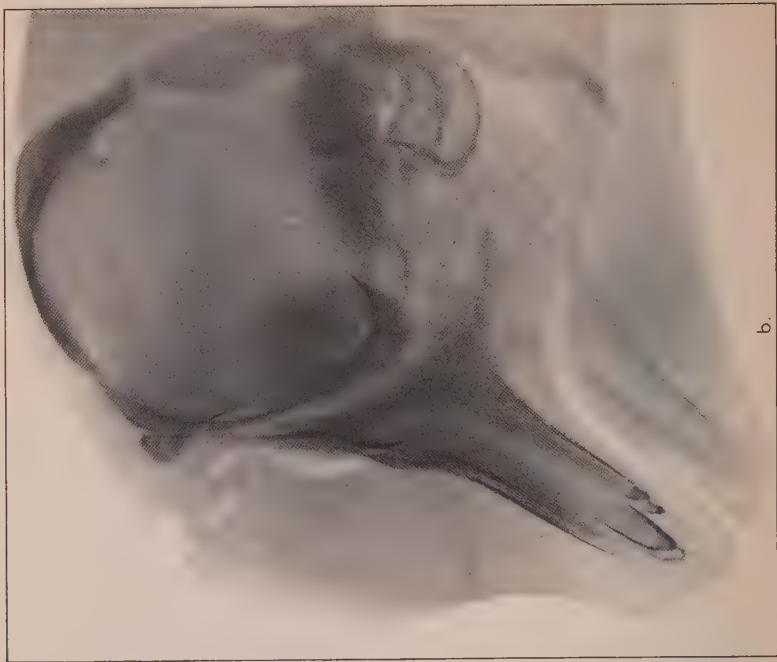
FIG. 1.—Ventral view of rostrum of 5' $2\frac{1}{2}$ " (158.8 cm.) ♂ foetus (Reg. no. 87.9.8.1), showing vestigial teeth and their sockets.

FIG. 2.—Dorsal view of same rostrum. The socket of the left tusk has been excavated, exposing the tusk along the whole of its length.

an aborted tooth, $\frac{1}{2}$ " (13 mm.) long and $2/10$ " (5 mm.) in its widest diameter. The hinder half of the aborted tooth was attenuated, and had several short irregular processes projecting from it, the anterior half was smooth and rounded. The tooth was enclosed in a distinct sac, formed by a fibrous tissue, which, like the sac of the rudimentary tusk, was firmly united to the fibrous tissues of the gum. There can be no doubt therefore that I was right in my conjecture that the more anterior dental papilla becomes the tusk of the Narwhal.' Actually the homologies of the teeth had been made clear by Cl. Mulder, to whom Turner makes no reference in his papers.



a.



b.

a. DORSAL VIEW OF HEAD OF 20½" (52 cm.) ♂ FOETUS. (Reg. No. 37.10.30.3).
b. LATERAL VIEW.

FROM X-RAY PHOTOGRAPHS.

In 'The Marine Mammals in the Anatomical Museum of the University of Edinburgh, 1912', Turner lists a number of Narwhal skulls which will be referred to later. Both foetal and adult specimens are mentioned in the catalogue, and he notes the occurrence of vestigial teeth.

In 1937 the British Museum (Natural History) purchased two adult female Narwhal skulls and also a male foetus measuring $20\frac{1}{2}$ " (52 cm.) in length, and it was the X-ray photograph of the head of this last specimen (Reg. no. 37.10.30.3), showing the tusk-forming teeth and the vestiges beside them, which gave rise to the present note.

The developing tusks in the foetus are $\frac{3}{4}$ " (19 mm.) long and $\frac{3}{16}$ " (4.7 mm.) in diameter. They are rounded at the distal end and have a widely open pulp cavity. The tips



FIG. 3.—End of rostrum of ♀ skull (Reg. no. 37.10.30.2), from an X-ray photograph. The position of the tips of the aborted tusks is indicated by dotted lines. Ventral aspect.

FIG. 4.—End of rostrum of ♀ skull (Reg. no. 85.2.20.1), from an X-ray photograph. Ventral aspect.

of the tusks extend to the end of the rostrum. This should be noted, for in the adult female both tusks, and in the adult male the right tusk, terminate several centimetres behind the rostrum tip. Situated beside the tusks, and external to them, is on each side a small top-shaped vestigial tooth in length $\frac{3}{16}$ " (4.7 mm.) and in greatest diameter $\frac{3}{32}$ " (2.5 mm.). Each vestigial tooth is constricted at the middle, tapering to a blunt point at the distal end, roughly rounded and having a wide pulp cavity at the proximal end (Plate 3).

The stage of development of the vestigial teeth in this specimen, as might be expected from the size of the foetus, is thus intermediate between that found in Turner's $7\frac{1}{4}$ " (18.4 cm.) specimen, in which there were dental papillae barely visible to the naked eye, and Gervais' $3' 10\frac{1}{8}$ " specimen

Observations on the teeth of Narwhals.

Collection.	Length of skull.	Sex.	Tusks.	Vestigial teeth.
Anat. Mus. Edin. No. 3, Turner's Catalogue.	13 $\frac{1}{4}$ " (33.7 cm.).	♀ juv.	R. and L. tusks at mouth of alveolus, but not protruded.	One inch behind right alveolus is a smaller socket in which the end of an aborted tooth is seen. A similar left socket does not contain an aborted tooth.
Anat. Mus. Edin. No. 4, Turner's Catalogue.	18 $\frac{1}{2}$ " (47 cm.).	♂ adol.	Left tusk projects for 1 $\frac{3}{4}$ ", right is concealed.	Behind each alveolus is a depression which may have lodged a vestigial tooth.
Brit. Mus. (N.H.). 32.7.22.1.	20 $\frac{1}{8}$ " (51.1 cm.).	♂ adol.	Left tusk 14 $\frac{1}{4}$ " (36.2 cm.) from tip to tip of rostrum. The tip of the right tusk 3 $\frac{7}{8}$ " (9.8 cm.) behind tip of rostrum.	A small depression on each side without tooth vestige.
Brit. Mus. (N.H.). 37.10.30.2.	20 $\frac{9}{16}$ " (52.2 cm.).	♀ adol.	R. and L. tusks embedded in bone of rostrum. The tip of the left 5" (12.7 cm.) and of the right 5 $\frac{5}{8}$ " (13.5 cm.) behind the end of the rostrum.	On the left side the only evidence of vestige is a wide shallow socket; on the right a tooth vestige in socket and partly projecting from it, its length $\frac{3}{8}$ " (16 mm.) and greatest width $\frac{1}{4}$ " (6 mm.). Piriform in shape. (Fig. 3.)
Brit. Mus. (N.H.). 85.20.1.	21 $\frac{1}{4}$ " (54 cm.).	♀.	R. and L. tusks embedded. Left tip 4 $\frac{3}{8}$ " (11.4 cm.) and right 5 $\frac{3}{8}$ " (13.2 cm.) behind the tip of the rostrum.	On the left side in a depression. A small nodular ossification ca. $\frac{1}{4}$ " (6 mm.) in diameter. No trace of ossification or alveolus on right. (Fig. 4.)

Brit. Mus. (N.H.). 1937.10.30.1.	♀.	22 $\frac{1}{8}$ " (56.2 cm.).	L. and R. embedded, that of left with tip 5 $\frac{1}{4}$ " (13 cm.) and of right 5 $\frac{3}{4}$ " (14.6 cm.) behind the tip of rostrum.	On the left side shallow depression), but no tooth on the right. A modular ossification of similar size and form as in preceding 85.2.20.1., diameter ca. 5 mm., and situated in shallow depression. (Fig. 5.)
Brit. Mus. (N.H.). 1917.8.2.1.	..	22 $\frac{1}{8}$ " (57.4 cm.).	'Bidental.' Left tusk (tip to insertion) 6' 2 $\frac{1}{2}$ " (189.3 cm.). Right 5' 7 $\frac{1}{2}$ " (171.5 cm.).	No trace of teeth or sockets on either side.
Brit. Mus. (N.H.). 1938.1.29.1.	..	23" (58.4 cm.).	'Bidental.' Left tusk 5' 10 $\frac{1}{2}$ " (179 cm.), right tusk 5' 9 $\frac{1}{2}$ " (176.5 cm.).	A shallow depression on each side, posterior and external to sockets of tusks.
Brit. Mus. (N.H.). 1934.6.19.1.	..	23 $\frac{1}{4}$ " (59.1 cm.).	'Bidental.' Left tusk 3' 9" Right tusk 3' 2" (114.3 cm.). (96.5 cm.).	A shallow depression on each side, but no trace of vestigial teeth.
Anat. Mus. Edin. No. 1, Turner's catalogue.	..	23 $\frac{1}{2}$ " (59.7 cm.).	'No tusks protrude and the sockets are filled with bone.'	'2 $\frac{1}{8}$ " behind the right socket is seen the tip of a rudiment of a second maxillary tooth lying at the bottom of its socket. A similar socket in the left maxilla has no rudimentary tooth in it.'
Roy. Coll. Surg. 2941. ♂.	♂.	24" (61 cm.).	Left tusk 6' 4 $\frac{3}{4}$ " (194.9 cm.). Tip of right tusk 5 $\frac{3}{4}$ " (14.6 cm.) behind tip of rostrum.	A vestigial tooth situated externally to and at the side of the socket of the fully developed left tusk. It is closely pressed against the alveolus containing the tusk and is only 2-3 mm. in thickness. Its length is 1 $\frac{5}{8}$ " (23 mm.) and greatest width $\frac{1}{8}$ " (11 mm.) (Fig. 6.)
Brit. Mus. (N.H.). 369 c. ♂	♂.	24 $\frac{3}{8}$ " (61.9 cm.).	Left tusk 6' 3" (190.5 cm.). Tip of right 7 $\frac{1}{4}$ " (18.4 cm.) behind tip of rostrum.	A depression on the right side, but no tooth.

in which the teeth were $5/16''$ (8 mm.) long, with greatest diameter $1/8''$ (3 mm.), and without trace of pulp cavity but piriform in shape.

Next in increasing size to these specimens are Turner's $5' 5''$ (165 cm.) foetus and the male foetus in the British Museum collection (Reg. no. 87.9.8.1), the articulated skeleton of which indicates that it was about $5' 2\frac{1}{2}''$ (158.8 cm.) long. Turner's specimen had on each side, in addition to the tusks, a vestigial tooth $\frac{1}{2}''$ long and $2/10''$ wide. The British Museum specimen (fig. 2) has the tooth vestiges wired on to the rostrum in the vicinity of two deep sockets about $1''$ (2.5 cm.) long which run backward parallel to those containing the tusks. The vestiges are in length, the left $3/8''$ (9.5 mm.) and the right $5/16''$ (8 mm.) and each has a diameter of about $1/8''$ (2.5 mm.). As shown in the figure the teeth are constricted at the middle of their length, taper to the crown and more so to the root. There is no trace of pulp cavity.

In order to find out what ultimately happens to the vestigial teeth I examined the Narwhal skulls in the British Museum and one at the Royal College of Surgeons, and (Table I) have tabulated the observations together with those described in Turner's 1912 catalogue. With regard, first of all, to the tusk-forming teeth (which in the female, of course, normally remain embedded in the rostrum throughout life), it is seen that in young specimens as in foetuses the tips of both tusks extend to the end of the rostrum. In the adolescent specimen, Reg. no. 32.7.22.1, the tip of the aborted right tusk is 9.8 cm. behind the distal end of the rostrum and in the adult specimens the end of the aborted tusks or tusks is from 12.7 to 18.4 cm. from the tip of the rostrum.

The fate of the second pair of teeth is in marked contrast to that of the tusk-forming pair. Like the latter, in foetal and very young specimens, they are situated at the antero-lateral edge of the rostrum with their apices at the distal ends of the very deep alveoli into which the teeth are inserted; but unlike the tusks the second pair maintain their original position, the alveoli close up from behind and persist in the adult only as shallow, often indistinct depressions.

The asymmetrical growth of the tusks in the Narwhal is, of course, very well known, and it has its extreme expression in the male, in which the left tusk may be several feet in length whilst the right is hidden in the bony tissue of the maxilla. But even in female specimens, although both tusks are of approximately equal length, the left is persistently the longer of the two. In the bidental skulls also—specimens in which both tusks grow out beyond the tip of the rostrum—the left tusk is always rather longer than the right. The observations recorded here corroborate those of J. W. Clark

in 1871. All the bidental specimens mentioned by him, which have the tooth length recorded, show that the left tusk is longer than the right. The vestigial teeth on the other hand give no indication of superior persistence on the left side. Of the seven adult specimens in which vestigial teeth are recorded in four they are on the right side and in three they are on the left.

It might be thought also that the tendency would be for the vestigial tooth to be obliterated in males on the left side as a result of the great development of the tusk on that side, but on the contrary we find that in the largest specimen but one examined there is a vestigial tooth of considerable size tucked in at the side of socket of the left tusk (fig. 6).

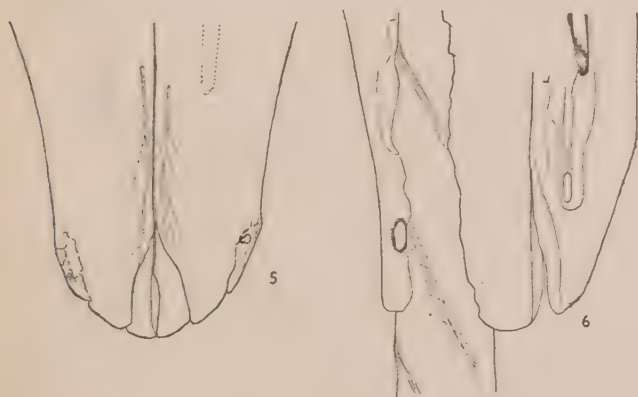


FIG. 5.—End of rostrum of ♀ skull (Reg. no. 37.10.30.1) from an X-ray photograph. Ventral aspect.

FIG. 6.—End of rostrum of ♂ skull (Roy. Coll. Surg. 2941). The aborted right tusk has been exposed. Ventral aspect.

In general, the observations of the available material indicate that in the Narwhal the persistence of the vestigial teeth in the adult is not infrequent in its incidence. Not only are vestiges themselves found, either on one or other side of the upper jaw, but depressions, similar in form and position to those in which vestiges are found, in the rostra of several skulls suggest that the incidence of vestigial teeth may be even greater than the actual occurrence indicates. The teeth being loosely inserted are probably lost during preparation.

BENEDEN, P. J. VAN. 1889. *Mém. cour. Acad. R. Belg.* XLIII. p. 237.

— & F. L. P. GERVAIS. 1879. *Ostéographie des Cétacés*. p. 523.

CLARK, J. W. 1871. *Proc. Zool. Soc. Lond.* p. 42.

GERVAIS, P. 1873. *Journ. de Zool.* II, pp. 498–500.

- HOEVEN, J. VAN DER. 1858. 'Handbook of Zoology', II, p. 626.
(W. Clark's translation.)
- MULDER, CL. 1835. *Tijdschr. voor natuurl. Geschiedenis*, pp. 65-109,
pl. II.
- RAPP, W. 1837. 'Die Cetaceen', p. vi.
- TURNER, Sir W. 1872 a. *Journ. Anat. & Physiol.* 2nd ser. no. XI,
p. 75.
- 1872 b. *Proc. Roy. Soc. Edin.* VII, p. 759.
- 1878. *Proc. Roy. Soc. Edin.* IX, p. 103.
- WIEGMANN, A. F. A. 1836. *Archiv für Naturgeschichte*, II, p. 290.

Discussion :—

Dr. W. T. CALMAN asked whether the vestigial teeth described by Dr. Fraser showed any trace of the spiral structure which is characteristic of the tusks of the narwhal.

Dr. FRASER replied that there was no trace of such a spiral structure.

SOME CONCEPTIONS ABOUT GEOGRAPHICAL DISTRIBUTION AND ORIGIN OF SPECIES.

BY J. C. WILLIS, Sc.D., F.R.S., F.L.S.

I. SURNAME-DISTRIBUTION OF FARMERS IN CANTON VAUD (SWITZERLAND).—As a sequel to Guppy's study of surname-distribution in Britain, which showed a good 'hollow curve' by counties, the author has studied Canton Vaud, which is about as large as Gloucestershire, but much broken up into more or less isolated valleys by mountains larger and smaller. Its nineteen 'districts' average 63 square miles each, and they show as good a curve as, or even better than, that of the English counties. A very great number of the villages, especially in the more rugged districts, contain endemic names found nowhere else in the Canton. Not infrequently these occur on more than one farm, and then they usually show a curve just like that of plants, with the greatest number upon the smallest area (here one farm). The spread of a name may be due to various causes that can hardly be regarded as other than chance, as for example the chance that a farm may fall into the possession of a woman of family X. If she marry a man of family A, that family will rise in status by one farm, and X may even be extinguished. The same process happens with plants, and the plant (or the surname) that increases its numbers increases its chance of spreading. The bulk of the villages in the Canton have one or more names exceeding the rest in number, and in general these names show greater dispersal in the Canton (just as the commoner plants in Ceylon, for example, show greater dispersal outside the island). Spread

is alike in the two cases, so that it becomes very difficult to call in adaptation or natural selection as the chief causal agent in distribution. Rochat, for example, is the commonest name in the valley of Joux, and has spread the most widely of the Joux names in the Canton. But there is no adaptation, nor any handle for natural selection, in the possession of Rochat as a name. No *single* plant, and no *single* owner of a name, of course, can become established anywhere without passing through the sieve of natural selection, but that is its chief action. The effect of selection upon a name, or upon a species, will be the sum of its effects upon the individuals, and one must remember the failures.

II. ORIGIN AND DISTRIBUTION OF SPECIES AND GENERA OF PLANTS.—No theory of origin can stand if it cannot explain, to a great extent, at any rate, the facts of distribution, and, while I feel that origin has probably taken place in several ways, I also feel that a theory of sudden origin will explain a great many facts that seem to me inexplicable upon the theory of origin by the accumulation of small differences, unless the successive appearance of these differences is determined by some more powerful agency than natural selection appears to be. A new species (on my view), or a new form (on the current one) would at once have to pass through the sieve of natural selection, and prove suitable, not only to the average conditions of the locality, but to the whole range of those that may occur there.

The theory of sudden origin is, of course, not my own; it was first published in pre-Darwinian days by Geoffroy St. Hilaire, if not earlier; it was pushed by Owen and Mivart in the 'sixties; it was restated by Guppy, after his many years of South Sea island experience, in 1906, under the title of the theory of Differentiation, and by myself, after ten years' experience of tropical vegetation, in 1907.

The theory of accumulation of small differences, of course, must almost of necessity base itself upon adaptation, for without this there seems little or no reason for the accumulation. But though the first species of a genus may have some useful adaptation that renders it likely to spread a little faster than usual, there seems no reason to suppose that other species of the same genus, formed later, must necessarily show the same adaptation; yet we constantly find many species in a large genus that all occupy areas of large, though usually of different, size. Adaptation, therefore, if, as generally supposed, it determines the success or otherwise of genera, must be generic, and not only specific. It may even be mainly internal. But, as far as our present knowledge goes, no one can point out what, for instance, is the adaptation

which has led to the success of *Senecio*, *Astragalus*, or *Dryopteris*, with their enormous numbers of species living in the greatest variety of conditions.

Probably what these genera, which by reason of their great numbers and their world-wide distribution may be regarded as being very old members of their respective families, really possess, is *adaptability*, rather than adaptation as such. They are usually comparatively simple in structure, and have not become so fixed as to render change more difficult; and they usually show, as Guppy pointed out, great variability.

One must always remember, also, a fact that is rather liable to be forgotten—that very great differences may, and often do, show themselves between species that otherwise agree closely in their characters, and also that the larger the genus or the family the more probable is it that these differences will appear. So much is this the case, that it is a matter of agreement among systematists that the same character may be at different times of family, of generic, or only of specific rank, and that only experience can show what its real value is for any particular group. I have given a list of many such characters (Ann. Bot. xxxvii, pp. 620 seq.; 1923) with many instances of this, such as the appearance of a superior ovary where one would naturally expect an inferior (32 mostly large families), the unexpected presence or absence of endosperm, and so on. And I have given a list of fifteen pairs of palm genera, each pair in the closest possible relationship, where one of each has, the other has not, ruminate endosperm—the same distinction of characters that is the safest criterion between the Annonaceae and the Magnoliaceae.

I have also tried to show ('Age and Area') that there is little reason to suppose that the bulk of localized or endemic species, genera, and families are to be regarded as relics of an older time and of more widely distributed species. On the contrary, it is more probable that they are usually what we may call young beginners, which have not yet spread over larger areas simply because they have not yet had sufficient time in which to do so, or because they have been held up by the presence of barriers of some kind, physical or ecological.

There is no doubt whatever that living relics occur, but not in the vast numbers formerly thought probable. Species show similar effects of age, when taken in comparatively small groups. The 'hollow curve of distribution' (the compound interest curve) is also emphatic against the relic explanation, and both these things go to show that adaptation is not so powerful an agent as is often supposed.

Whilst when first published both these conceptions—Differentiation and Young Beginners—were much opposed to current beliefs, there is no doubt that the latter, at any rate,

is gaining ground, as may easily be seen by looking at various recent publications in systematic botany, where a great part of the endemic species are now admitted to be new. The first conception is also beginning to receive support. Systematists have in recent years made important additions to the evidence for mutational origin of species and genera, though themselves only trying to place these species and genera nearest to those which appear to be most closely related to them.

If one take as illustrations some of the more recent monographs in Engler's 'Natürlichen Pflanzenfamilien', one notices at once the great geographical separations of closely allied species, genera, subfamilies, families. In *Cardamine*, for example, species no. 70 is in New Zealand and Polynesia, no. 71 in the Azores, no. 72 in Chile. In *Euphorbia* one finds allied species in Venezuela and Cape Colony, in Persia and in Africa, in central Asia and in N. America, and so on. If in the Drabeae (of Cruciferae) one join the consecutive related genera by a line, one crosses the Atlantic five times and the Pacific once, and usually goes well into the continent also. In the Arabideae the crossings are seven and six respectively, and in the Lepideae the whole map is covered with a web of lines.

Now with relationship like this, which is so much complicated by the great separations over the surface of the globe, to get an explanation by the method of accumulation of small differences is an extraordinarily difficult matter, and it is much simpler to call in the *linking genera* that cover the enormous gaps than to suppose that the related genera, say in Chile and Siberia for example, once overlapped or nearly overlapped each other, and that then destruction took place upon an enormous scale, and through all varieties of conditions and climates. All three of these subfamilies have various genera that cover the whole or much of the range, and it is much simpler to regard these as connecting links—as in fact the *ancestors*, directly or at times indirectly through intermediate genera, of the small scattered (though so often closely related) genera. One may take any view one pleases as to how they were derived from these large and widely distributed linking genera, though personally I hold to the views expressed in 1907, when pointing out how all the existing Dilleniaceae might have been derived, directly or indirectly, from *Tetracera*, the most widespread and about the simplest of the family. The only necessary thing is to get rid of the idea that small genera and species of restricted area are necessarily relics, and we have seen that this conception is now definitely losing ground.

If one suppose a genus to give off new species more or less in proportion to the area that it covers * (which again will

* For the mathematical consideration of the question, cf. Yule in *Phil. Trans. B*, 213, 1924, p. 21.

be more or less in proportion to its age among its peers), it is clear that all the offspring will carry a large proportion of the characters of the parent, and that therefore while offspring arising near together will be most likely closely to resemble one another, there is no reason why a close resemblance should not arise with a wide geographical separation.

It is rare to find a genus going far outside the limits of the genus that may be looked upon as the linking genus (e.g. *Draba* in Drabeae). When it does, one may imagine that in its 'make-up' there was included a greater suitability to conditions that may be a barrier to the parent—it may be capable of growing in warmer (or colder), wetter (or drier), or otherwise different localities.

The author is not attempting to set up this 'parent and child' theory as a universal rule, nor at present attempting to apply it to zoology; but there is no doubt that it will apply very well to most of the small families of plants, to a great number of the larger families, to a great number of the subdivisions of families, and to a great number of genera whose species behave as do those genera that we have been dealing with. The question will later be treated in greater detail in a book.

The theory of accumulation of small differences makes many of these and other phenomena very difficult to understand. To get two closely related genera or species so widely separated geographically by aid of the selection of small differences would be very difficult, for one would have to assume—if the differences be regarded as adaptational—that the conditions in the two places were very similar, though there is little evidence to that effect, or that the genera once touched one another in their distribution, and that there has been a vast amount of destruction. Not only so, but this destruction must have gone on through every variety of conditions to which the genera must have been adapted. There is *some* change and variety to be passed through between Greece and California, for example, or between Persia and Cape Colony, to take a couple of examples from the Lepideae.

It is probable that cytological study will throw some light upon this difficult problem.

III. CONTOUR-MAPS FOR GENERA AND FAMILIES.—A useful tool in the study of geographical distribution is what one may call, borrowing a name from the geographers, contour maps. The mere fact that one can construct such maps is a great argument in favour of the theory of differentiation, which we have just been considering.

If one take a monotypic genus, other than an obvious relic like *Magnolia*, one finds all its localities, with few instances to the contrary, within fairly easy reach of one another,

and one may draw round them an enveloping line which is like the contour of the sea round an island. Inside this contour, in larger genera, or more rarely overlapping it, one finds other smaller contours, like the inner contours of a geographical map which indicate the presence of hills. There may be one or more hills within the outer contour, and there may be one or more species within the contour of the original one, which will often, one imagines, be the parent of the rest. Contour maps of this kind are very common indeed with plants. An excellent example is the map of distribution of *Beta* (in *Naturl. Pflanzenfam.* 16 c, p. 461 ; 1934).

PROCEEDINGS OF THE GENERAL MEETING

5 May 1938

Mr. J. RAMSBOTTOM, O.B.E., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 21 April 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following candidates, whose names were read for the third time, were balloted for and elected Fellows :—Harry Arnold Baylis, M.A., D.Sc., Roger Fielding Notcutt, B.A., Mohammed Ahmeduddin Anwer, B.A., James Brady, B.Sc., A.R.C.S., Winifred Margaret Warden, M.Sc., Hamilton Blackiston, B.A., and George Philip Wells, M.A.

The following candidate, whose name was read for the third time, was balloted for and elected a Foreign Member :—Carl Jörgen Wesenberg-Lund, Dr.Phil.

The following candidate, whose name was read for the third time, was balloted for and elected an Associate :—Charles Edward Britton.

The President reported the death of William Thomas Elliott, Fellow of the Society.

The President gave a brief account of some of the arrangements for the 150th Anniversary Celebrations; and stated that the Council had decided to mark the occasion by returning to Uppsala two out of the three of the Herbarium cases which at one time contained Linnaeus's Herbarium.

The ZOOLOGICAL SECRETARY read the following letter from Dr. J. B. CLELAND, Chairman of Commissioners, National Park, South Australia, concerning the National Park near Adelaide :—

London, April 21st, 1938.

Dear Sirs,

The National Park in South Australia consists of about two square miles of country situated in the hills about 8 miles from Adelaide. It is vested in Commissioners under the National Park Act who are practically free to act in any reasonable way that they may deem fit. Much of the Park is still in its virgin condition of eucalyptus forest or scrub. Part has been altered considerably by grazing over many years. The Park is so close to Adelaide that it is visited by large numbers of persons most of whom are more interested in cricket, football, and golf than in rambling through the untouched scrub. On the other hand, untouched scrub and eucalyptus forest in the neighbourhood of Adelaide are rapidly disappearing and the National Park is the only portion that in a few years is likely to be left in its virgin state. To what extent, if any, is it justifiable to sacrifice portion of the scrub for purposes of sport, which incidentally are revenue-producing?

I am writing to you, as Chairman of the Commissioners, to ask whether it will be possible, through various channels such as the Linnean Society, the British Association, the National Trust for Ancient Monuments, etc., the British Museum, the Royal Botanic Gardens, etc., to have a really authoritative opinion expressed as to :—

(1) The definition of a National Park, with the objects to be kept in view.

(2) To what extent facilities for sport, especially when the Park is near a large city, may be allowed to take the place of part of the original flora and fauna.

I am, Yours truly,

(sgd.) J. B. CLELAND,

Chairman of Commissioners, National Park,
S. Australia.

The Secretaries,

The Linnean Society of London.

Professor T. G. B. Osborn said that, to judge from Professor Cleland's letter, the condition of the native flora in the National Park at Belair, South Australia, must be even less satisfactory than when he knew it, more than ten years ago. No doubt this was in part attributable to increased ease of access and rapidity of transport.

The Park consisted of a number of steep-sided valleys and contained several vegetation types characteristic of the Adelaide Hills, e.g., Stringybark Forests (*Eucalyptus obliqua* and *E. Baxteri*), sclerophyllous scrub, marginal forests of

Red Gums (*Eucalyptus camaldulensis*) along the water-courses. Of special scientific interest were certain seasonal swamps in which *Phylloglossum Drummondii* and *Isoetes Drummondii* were to be found.

The administrative policy of such a National Park was not easy to define. Should the area be treated as a fauna and flora reserve, or should it be a pleasure-park, or could the two objects be combined? The Trustees were hampered by lack of funds. The Government Grant was supplemented by

- (1) Fees for de-pasturing horses,
- (2) Stripping wattle-bark (*Acacia pycnantha*),
- (3) Hire of picnic facilities and sport areas.

Several ovals on which cricket can be played have been cleared and there are numerous tennis-courts. He understood that a golf-course had been added. The fees from the hire of tennis-courts, ovals, and picnic facilities in various arbours or pavilions of different sizes were an important source of revenue. These 'amenities' are used by large numbers of people during the summer months. He felt that if a Committee representative of the bodies mentioned in the letters could issue a short statement as to the object of the national parks and nature reserves, it might help Professor Cleland and others in Australia who were striving to preserve something of the natural features of the country for the future.

In conclusion, he mentioned that South Australia had a large fauna and flora reserve (about 200 square miles) at the western end of Kangaroo Island. This area, however, had a different fauna and flora from that of the Adelaide Hills. Hence the scientific interest of the National Park at Belair.

The PRESIDENT stated that the letter would be printed in the Society's 'Proceedings' (see above) and circulated to other Societies, adding that at an early meeting in the coming session the subject of Dr. Cleland's letter would be discussed.

Dr. FRANK R. LEWIS read a paper, 'Linnaeus, Valltravers, and Demidoff'. (Communicated by the PRESIDENT.)

Mr. T. E. James, the Assistant Secretary and the President added some comments, and Dr. Lewis replied. [This paper is printed in full below, p. 173.]

Miss M. T. MARTIN, M.Sc., F.L.S., gave an account, illustrated with lantern-slides, of her paper, 'The structure and reproduction of *Chaetangium saccatum* (Lamour.) J. Ag.—II. Female Plants'. [This paper, whereof there is a résumé on p. 117 above, will be printed in full in the Journal.]

Mr. CHARLES BELTRAND ALEXANDER (Visitor) gave an account, illustrated with lantern-slides, of 'The north-west coast of Australia as a field for biological research'.

Abstract.—

The speaker explained that for nearly twenty years he had lived in those isolated regions, navigating a fleet of pearling ships along 1,000 miles of imperfectly charted coast-line, and, looking on this wonderful tropical land and its great sea wealth, he had been astonished to learn that this territory is actually unknown to those naturalists, scientists, and institutions who are concerned in the study and accumulation of biological knowledge: for it appears that scientific research has been extensively carried out in Northern Australia from Port Darwin east to North Queensland, but that the coastal territory below Port Darwin from the Fitzmaurice River south to Collier Bay, on the West Kimberley Coast, has in some way been overlooked by exploring scientists, naturalists, and scientific institutions of Australia and other countries.

The Kimberley coast is the extreme northern division of Western Australia, and the question why this territory embracing 600 miles or more of the Australian coast has been so neglected may be answered by the peculiar conformation of the country itself, which is practically isolated from its hinterland some two hundred miles inland where there arises a formidable mountain barrier known as the Leopold Ranges. These mountains are of such rugged and broken character that only a few early white explorers were successful in finding a path to the coast, while the hardships they had to endure gave little opportunity to preserve perishable specimens, and so prevented them from adding to the knowledge of the fauna and bird-life in these regions.

The Kimberley seaboard presents similar difficulties in the way of approach from the south. The coast-line is of irregular formation, remarkably scenic, containing several magnificent harbours of great depth and area; but, fringed by hundreds of mountainous islands, coral reefs, and imperfectly charted rocks, it is most dangerous even to small sailing ships navigating the channels and passages, which are swept by powerful flowing tides caused by a rise and fall of the sea, which in some parts averages 38 feet in twelve hours.

Briefly, the first detailed knowledge of the West Kimberley coast was supplied by the 'Journals' of Sir George Grey, how in 1828 landed at Camden Harbour intending to make an exploration of the coast south to Fremantle. Unfortunately Grey fell a victim to the spears of the wild savage inhabitants and within a few months was forced to sail away—never to return. Some idea of Grey's impressions of this coast may be gained from an entry in his 'Journal' where he writes '...

We travelled along the Glenely River, and as I sat in the fading light looking at the scenery around me which now for the first time gladdened the eyes of Europeans, and I wondered that so fair a land should only be the home of savage men; wondered how long these things could be . . . ' One hundred years have since passed by—yet still this land remains unknown, the home of savage men.

The floral life of the Kimberley Coast is both rich and varied. One of the most beautiful sights is when water-lilies of the most delicate and variegated hues make their annual appearance on the surfaces of the creeks and billabongs. Tropical ferns, palms, and grapes very similar to the cultivated varieties both in appearance and flavour grow abundantly on the islands and coastal lands.

There is an abundance of game throughout the coast, in the form of kangaroos, wallabies, and numerous types of marsupials. Rock-wallabies and opossums are numerous. Many of the inland rivers contain turtles and the long-nosed crocodile, a saurian of about 5 feet in length, which lives on fish and is harmless to humans. In most of the tidal estuaries the man-eating alligator is fairly plentiful, attaining a length of over 20 feet. Two years ago when visiting the Victoria River north of Wyndham, the speaker met a mounted police trooper on patrol, who informed him that his native 'boys' during the past twelve months had destroyed over 10,000 alligator eggs.

Of the bird-life of the Kimberleys Grey in his 'Journal' says . . . 'In no other country that I have yet visited do birds so abound. Even the virgin forests of South America cannot in my belief boast of such numerous feathered denizens. They possess in many instances an excessively beautiful plumage: and he alone who has traversed these wildly romantic regions, who has beheld a flock of many-coloured parrakeets sweeping like a moving rainbow through the air, whilst the rocks and dells resound to their playful cries, can form an adequate idea of the scenes that there burst on the wondering eyes of the naturalist. . . .'

This enthusiasm was similarly expressed by surveyor William Easton, who in 1921 made an investigation of the Kimberley coast for the location of a site for a new port—he says: 'I noticed the creeks and billabongs were alive with several types of wild ducks, geese, pelicans, ibises, cranes, brolgas, etc. Pheasants and quail were most numerous, while several types of pigeons were most plentiful and tame that they would frequently alight a few yards away from us. . . . ' He continues: ' . . . From an ornithological point of view, the north Kimberley coast is very interesting and later researches may prove it to contain many birds new to science.

In addition to the birds already mentioned numerous others were seen, amongst which may be mentioned several types of wrens, cockatoos, parrots, kites, owls, minahs, honey-eaters, bell-birds, kingfishers, bower-birds, robins, whistling eagles, etc.'

The speaker added that with nearly twenty years daily experience in deep-sea diving he felt confident that a scientific research of the marine life in the West Kimberley waters would provide biological specimens of scientific interest equal to the collections obtained along the Great Barrier Reef on the Queensland side. Without doubt the teeming sea-wealth of that coast represents a storehouse of unknown dimensions.

The speaker ended: 'My great wish to-day is to enthuse everyone to join my efforts and help to bring about an expedition to that coast. I feel that I have presented a unique opportunity to scientists and naturalists. This coast is no longer uncivilised, there are one or two missions established there which have helped to civilise the one time savage inhabitants.

'To-day the north Australian coast is uninhabited by Europeans, but already Japan is annually sending down large fleets of well-equipped vessels to take their toll of the great sea-wealth of those waters. To-morrow it may be too late—who can say? But from the scientific aspect I will point out that past omission may have disappointing results if longer neglected, as this view-point was vividly represented to me a short while ago by a member of the Perth Museum in Western Australia, who informed me that there were known areas in the north-west which in 1854 contained numerous hare wallabies, pig-footed bandicoots, the nest-building rat, and the warrung. All these animals are now extinct in those areas, which cannot be attributed to white settlers, but to one of those inexplicable calamities that now and again decimate life from wild animal communities.

'Much remains to be achieved by the scientists before the advance of settlement terminates the present-day nomad state of this territory. It is one of the important tasks remaining for those who would learn the secrets of bygone ages and place on record those things which exist to-day, but to-morrow may disappear for ever.'

Mr. JOHN S. COLMAN (Visitor) gave an account, illustrated with lantern-slides, of 'The collections made during Lord Moyne's cruise in the yacht 'Rosaura' from Greenland to the West Indies'. [Cf. abstract on p. 104.]

Lord Moyne (Visitor) added some comments.

The following papers were read in title :—

‘On the nomenclature of the currant tomato, *Lycopersicum pimpinellifolium* Mill.’ By Dr. T. E. T. BOND. (Communicated by Prof. J. R. MATTHEWS.) [This paper is printed in full below, p. 181.]

‘Florula of the island of Espiritu Santo.’ By Prof. A. GUILLAUMIN. (Communicated by the PRESIDENT.) [This paper will be printed in the Journal—Botany.]

‘Studies in the Arabian Orthoptera.—II. New and little known Mantidae and Phasmidae’. By Dr. B. P. UVAROV, F.L.S. [This paper will be printed in the Journal—Zoology.]

LINNAEUS, VALLTRAVERS, AND DEMIDOFF.

By FRANK R. LEWIS, M.A., D.Phil., F.R.Hist.S.

[Communicated by the PRESIDENT.]

IN the reign of Alexander I, the Russian Universities were enriched by a public benefactor whose munificence bears comparison with the gifts of Viscount Nuffield to the University of Oxford. Paul Gregorovitch Demidoff (1738–1821) was a scholar himself who devoted his life to the encouragement of science and learning*. In 1803, he divided 100,000 roubles between the Universities of Kiev and Tobolsk, and to the University of Moscow he granted, in addition to another 100,000 roubles, his immense library catalogued according to his own system of classification and his cabinet of natural history. On 6 June, of the same year, the Tsar ordained, therefore, that a special gold medal should be struck, with the effigy of Demidoff on one face, and on the other an appropriate inscription celebrating his unparalleled generosity. A presentation-ceremony took place in the Senate at Moscow †.

When Paul Demidoff came of age, he proceeded on the Grand Tour in company with his two brothers and a Swiss gentleman named Rodolphe de Valltravers. In 1759, he visited a number

* Ogarkov, V. V., ‘Demidovui, ikh zhizn’ i deyatelnost’ (St. Petersburg, 1891), pp. 81–5. I have been unable to consult Golovshikov, K. D., ‘Pavel Grigorievitch Demidov i istoria ozvannovo im v Yaroslavye utchilishtsha’ (St. Petersburg, 1887).

† ‘Catalogue Systématique des Livres de la Bibliothèque de Paul de Demidoff’, with an introduction by Fischer, G. (Moscow, 1806), pp. xx, xxiii–xxiv. Cf. Da Prato, C., ‘Firenze ai Demidoff’ (Florence, 1886), pp. 44–9; and Storch, H., ‘Russland unter Alexander dem Ersten’, i (St. Petersburg and Leipzig, 1804), pp. 223–4.

of towns in England, Wales, and Scotland, and at Glasgow he was elected an honorary burgess*. The party stayed for a day or two in Flintshire with Thomas Pennant, and on 28 February, 1760, the day before they left England, the Welsh naturalist gave them a letter of introduction to Linnaeus†. Paul's father, Gregory Demidoff, had also written frequently to Linnaeus in the past, and on 13 June, he renewed the correspondence when he commended his sons to Linnaeus's friendly tutelage when they should arrive in Sweden‡.

Let us now indicate how Paul Demidoff's tour involved Linnaeus in another connexion with England. A few years earlier, on 22 March, 1754, the Society for the Encouragement of Arts, Manufactures, and Commerce was founded in London§. Rodolphe de Valltravers had been elected a Fellow of the Royal Society on 12 June, 1755||, and whilst he was in England with the Demidoffs, he established contact with this new institution. It was perhaps Valltravers, too, who persuaded Linnaeus to deliver a course of instruction to the young Russian nobleman. With regard to this tuition Linnaeus's own words may be quoted:—'I have worked a good deal harder than other men during the holidays', he wrote in a letter to Abraham Bäck; 'during September I have been reading three hours a day, in Botany and Zoology at 10 o'clock and 11 o'clock respectively in the morning, and on Mineralogy at 3 o'clock in the afternoon'¶. It must be recorded, however, that Linnaeus was handsomely rewarded for his tuition**.

Valltravers did not forget the agricultural interests of the London Society of Arts whilst he was at Uppsala. He managed

* 'Catalogue Systématique', pp. ix-x. I am informed by the Corporation of Glasgow that the record of this grant of honorary citizenship has disappeared.

† Linnaeus's Correspondence, xi, ff. 424^r–425^r, 461^r. For some valuable suggestions relating to Linnaeus's correspondence and the preparation of this paper, I am indebted to the courtesy of Mr. S. Savage, F.L.S.

‡ *Ibid.*, iii, f. 252^{r-v}. See Appendix, no. 1. For Gregory Demidoff, see Stejneger, L., 'Georg Wilhelm Steller' (Cambridge, Mass., 1936), pp. 459–79.

§ Wood, Sir H. Trueman, 'A History of the Royal Society of Arts' (London, 1913), pp. 11–12.

|| 'The Record of the Royal Society of London', 3rd edition (London, 1912), p. 347.

¶ This letter is dated 19 September, 1760; 'Bref och Skrifvelser af och till Carl von Linné, v, ed. Fries, Th. M. (Stockholm, 1911), p. 87.

** Fries, Th. M. 'Linné' (Stockholm, 1903), ii, p. 13; 'Härmed är det icke sagdt, att han af sina privatissime kollegier hade alls ingen ekonomisk fördel; tvärtom betalte förmögna lärjungar, visserligen efter eget godtfinnande, men dock ofta rikligt, stundom t.o.m. furstligt. Så t. ex. erhöill han för den kurs, som han genomgick med ryska baronerna Demidoff, icke mindre än 3,500 dlr.'

to persuade Linnaeus to promise a paper 'with the result of all his Discoveries and Experiments relating to such Plants as are fittest to feed cattle at all Seasons of the year, *especially towards the end of Winter*'. On 3 October, 1760, he wrote to the Society telling its members of his achievement, and describing the delight with which he and the Demidoffs had listened to Linnaeus's exposition, and the profit which they had derived therefrom. He expressed his opinion that Linnaeus had not much longer to live, and his sorrow that Linnaeus's 'numerous' children might be faced with hard times if their father were to die*. It is a little curious that Valltravers should have made this statement, for Linnaeus lived for eighteen years after 1760. Moreover, judged by eighteenth-century standards, his family was not so large as Valltravers seemed to think. Linnaeus had seven children, namely, Carl, who became a Professor at Uppsala (1741-83); Elisabeth Christina (1743-82); Sara Magdalena (1744); Lovisa (1749-1839); Sara Christina (1751-1835); Johannes (1754-7), and Sophia (1757-1830)†. Only five of these were alive in 1760.

Valltravers's letter was read to the Society of Arts at a meeting held on Wednesday evening, 5 November, 1760‡. Nearly a year passed, and then on 2 September, 1761, Valltravers was elected a corresponding member§. On 7 April, 1762, on the proposal of Joseph Banks, a similar honour was bestowed on 'Charles Linnaeus, Knight of the Polar Star, Physician to their Swedish Majesty's, Professor of Botany and Natural History at Upsal, and Member of the Principal Royal Academies of Sciences in Europe'.

On 15 June and 12 July, Valltravers wrote to Linnaeus from London, telling him of his election¶. Before the second letter was written, however, Linnaeus speedily prepared his promised paper on grasses and despatched this to Valltravers for the Society on 4 July. When it arrived, Valltravers was on the point of departing from England, so he passed it on to the Secretary, Dr. Peter Templeman. The paper (in Latin) being read on 4 August, the following resolution was passed by the members present on that occasion:—

'Ordered that the Secy. write a letter of thanks to Dr. Linnaeus, and that he be acquainted of his having been already elected a Correspondg. Member. Ordered that a copy of the above Letter together with a Translation be preserved in the Guard Book'**.

* See Appendix no. 2.

† See the genealogical table in Fries, Th. M., 'Bidrag, till en Lefnadsteckning öfver Carl von Linné' (*Uppsala Universitets Arsskrift*, Upsala, 1893), p. 53.

‡ Minute Book, 1760-1, p. 43.

§ *Ibid.*, 1761-2, pp. 25, 31.

¶ *Ibid.*, pp. 25-31.

¶ Linnaeus's Correspondence, xvi. ff., 13^{r-v} and 16^r. See Appendix, nos. 3 and 4.

** Minute Book, 1762-3, p. 12.

In accordance with these instructions a copy was preserved in one of the Society's Guard Books, but it does not appear that a translation was made. The many spelling errors* in the transcript suggest that the copyist was no Latin scholar and no botanist. It may be, however, that Valltravers kept the original letter himself—we know how he valued his friendship and correspondence with Linnaeus—and submitted an inaccurate copy to the Society. The characteristic modesty of the true scholar is apparent in the letter:—‘ You have set me ’, declares Linnaeus, ‘ a problem beyond my ability to solve ’. He is obviously very gratified by the project to make him a corresponding member of the Society of Arts, but he does not appear to be informed about the Society's functions. The letter ends with a word of praise for Solander which is of especial interest †.

On 18 August, Dr. Templeman wrote to Valltravers, who was in Berne at the time, enclosing the Society's thanks to Linnaeus for his paper. This letter was written in English, so on 1 December, Valltravers forwarded a Latin translation to Uppsala. The latter is now preserved in Linnaeus's Correspondence by the Linnean Society ‡. It is worthy of note how Dr. Templeman's letter made the Grand Tour—from London to Berne, from Berne to Uppsala, and from Uppsala back to London.

One or two further points may also be added in conclusion. Linnaeus remained a corresponding member of the Society of Arts for about twelve or thirteen years §, but his name is omitted, curiously enough, from a list of members published in 1777, the year before his death. During this period Valltravers wrote to Linnaeus and to the Society of Arts fairly frequently ||. Paul Demidoff also retained contact with Linnaeus and nine of his letters are preserved among the Linnean Correspondence ¶.

NOTE.—*Some MSS. in the National Library
of Wales, Aberystwyth.*

There were a number of Welsh natural historians of considerable ability in the eighteenth century, and, through the courtesy of the National Librarian of Wales, Mr. W. Llewelyn

* Such of these errors in the names of the plants, as are obvious, have been corrected in the copy printed below.

† Guard Book, ii, no. 50. See Appendix, no. 5.

‡ Linnaeus's Correspondence, xvi, f. 18^r. See Appendix, no. 6.

§ ‘ A List of the Society for the Encouragement of Arts, Manufactures, and Commerce ’ (London, 1775), p. 66.

|| Linnaeus's Correspondence, xv, ff. 3^r–31^v. Guard Book, vii, nos. 49, 121, etc.

¶ Linnaeus's Correspondence, iii, ff. 254^r–271^v. These letters are written in German.

Davies, I have been provided by Miss E. V. Panchen with references to some interesting manuscripts preserved at Aberystwyth. Among the Wigfair Papers there are a number of letters written by Thomas Pennant (1726-98), a correspondent of Linnaeus*, and of Sir James Edward Smith†. Pennant wrote frequently to John Lloyd, who shared his interests, and one of his letters (16 April, 1773), for example, is endorsed by Lloyd, 'Received April the 19th remember to ansr. to it to tell him what Dr. Linneas says of his Scotch Tour'. Thomas Johnes of Hafod (1748-1816), too, was not only a correspondent, but also a close personal friend of the first President of the Linnean Society‡, and there are nearly ninety of his letters in the National Library of Wales. The student of eighteenth-century natural history must necessarily take into account the rich quarry provided by the letters of Pennant, Johnes, the Rev. Hugh Davies, and other workers in the Principality.

APPENDIX.

SOME LETTERS FROM LINNAEUS'S CORRESPONDENCE AND THE ARCHIVES OF THE ROYAL SOCIETY OF ARTS.

1. GREGORY DEMIDOFF to LINNAEUS: St. Petersburg, 13 June, 1760. (Linnaeus's Correspondence, iii, f. 252^{r-v}).

Monsieur,

La crainte d'interrompre Vos occupations aussi importantes qu'utiles au monde littéraire, sans pouvoir justifier cette liberté par quelque chose qui méritât Votre attention m'a obligé depuis quelques années de me renfermer dans des bornes de silence. Charmé du désir de mes trois fils de voir la Suede, et de profiter de Vos savantes instructions, j'embrasse avec plaisir une occasion aussi favorable pour me rappeler dans Votre souvenir. Agrées, Monsieur, que je recommande mes fils à Votre bienveillance et que pendant le séjour qu'ils se proposent de faire à Upsala, ils puissent recourir à Vos secours et à Vos lumières. De retour dans leur Patrie ils joindront leur reconnaissance à la mienne et s'empresseront avec zèle d'exécuter Vos ordres en tout ce qui pourra mériter Vos recherches dans les différentes parties de l'histoire naturelle. Instruits par Vos soins, ils me seront en même tems [*sic*] d'un grand secours pour renouveler notre Correspondance, et pour Vous prouver dans toutes les occasions la considération distinguée avec la quelle j'ai l'honneur d'être,

Monsieur,

St. Petersburg,
le 13 Juin, 1760.

Votre très-humble et
très-obeissant serviteur,
GRIGOREI DE DEMIDOFF.

* Linnaeus's Correspondence, xi, ff. 410^r-468^v.

† Dawson, W. R., 'Catalogue of the Smith Papers' (Linnean Soc., London, 1934), p. 73.

‡ *Ibid.*, pp. 57-9.

2. Extract from a letter written by RODOLPHE DE VALLTRAVERS to the SOCIETY OF ARTS: Upsala, 3 October, 1760. (Royal Society of Arts, Guard Book, v, no. 46.)

The opening of a correspondence betwixt the Society for promoting Arts and Commerce of London, and our lately established Society for promoting Agriculture of Berne is a most happy event. The honour and advantage will be very great on our side; may it be in our power to make early returns, adequate to our just veneration and attachment to the British Nation.

Dr. Linnaeus (whose favourite study has been Agriculture these many Years, and whose observations on so important a Subject are very ingenious and founded on Facts only), has engaged himself to furnish your honourable Society with the result of all his Discoveries and Experiments relating to such Plants as are fittest to feed Cattle at all Seasons of the Year, *especially towards the end of Winter*; with such Directions as are requisite in the application. It will be written in Latin, and transmitted to Dr. Templeman, Secretary of your illustrious Society, by the hands of Mess. Jenings and Finley, Stokholm.

Poor Linnaeus. His health is so much impaired by continual labours and waste of Spirits that he cannot live long. His family is very numerous and yet unprovided. A quick, penetrating, ingenious and excellent Mind! the delight which my Fellow Travellers and I receive from his instructions three hours a day, cannot be expressed; and nothing can equal our obligations and Reverence to him.

3. Extract from a letter from VALLTRAVERS to LINNAEUS; London, 15 June, 1762. (Linnaeus's Correspondence, xvi, f. 13^{r-v}.)

f. 13^v. Liceat mihi, Vir Illustrissime, Nomen tuum Albo Societatis, pro promovendis artibus et Comerciis hujus Regni, unanimi omnium Sociorum Consensu, inserere; Nobilissimumque istud Institutum Britannicum (quod hoc Anno 15 Millia Librarum Sterlinarum in Distributione premiorum absque ullo Auxilio publico vel Regis impendit) conatibus Tuis supplicare.

4. Letter from VALLTRAVERS to LINNAEUS: London, 12 July, 1762. (Linnaeus's Correspondence, xvi, f. 16^r.)

Londini, 12^o Julii 1762.

Vir celeberrime,

Accipe, quem Sibi, Meritisque tuis immortalibus Societas nostra æconomica decrevit Honorem. Albo laudabilissimi hujus Nationis Instituti inscriptus, Lucem Veritatis, Sagacissimasque Tuas in cunctis Almæ Naturæ Regnis observationes, et hic Terrarum in Emolumentum Generis humani, spargere grata Tibi erit Occasio. Gratissimaque erunt, quæcunque transmittere Tibi placebit huic Societati utilissima Tua Cogitata atque Inventa.

Lares helveticos revisurus, Tibi ubique et semper omnia fausta atque læta apprecor non immemor omnium Tuorum Benefactorum; Teque toto Animo amare atque sincerrime venerari nunquam desinet—

Nominis Tui celeberrimi

Cultor humillimus RODS. Á VALLTRAVERS.

Fata Epistolæ meæ 23. Febr.
ad Te nondum audiui.

5. LINNAEUS'S PAPER ON GRASSES FOR FEEDING CATTLE, sent to Valltravers for the Society of Arts : Upsala, 4 July, 1762. (Guard Book, ii, no. 50.)

Viro vere Nobili Dno. Rod. Valltravers. S.pl.d. Car. Linnaeus.
Tuas Vir Nobilissime die 15 Junii rite habui ante triduum.

Accepi D. Lee Philosophiam Botanicam, quae valde pulchra erat, et me multo honore affecit. Doctos profecto apud vos habetis Hortularios, qui ejusmodi opera valent conficere.

Multum laboravi primo Vere cum Graminibus ad Tuum Mandatum, sed mihi injunxisti nodum solvendum cui par non fui ; omni, meo labore vix aliud didici, quam quod gramina maxime borealia omnium praecocissima sunt, contra meridionalia sunt serotina omnia, cum tamen contrarium quivis expectaret ; adeoque Sibiria [? Sibirica] et Lapponica § omnium prima sunt licet in sua patria non germinant ante initium junii, et australia, italica, hispanica, quae in patria erumpunt mense februario, apud nos vix ante medium maii prodeunt ; et quod singulare, unum idemque Gramen, e maxime boreali nostra Westrobotnia allatum, per 18 dies prius germinat tempore vernali, quam idem s. eadem species, quae sponte apud nos provenit : adeoque semina quaerenda graminum e terris Septentrionalibus.

Sed hoc soluto nodo alius nodus persistebat mihi longe durior, nempe Quodvis Gramen duo habet necessaria sibi requisita, alterum *Terra* ex qua crescat, scilicet Humus, Arena, Argilla, Creta, &c., alterum *Solum*, e.g. elevatum, depressum, aquosum, cultum &c. Accidit saepe tertium Circumstantia ; alia enim expetunt aprica §, alia umbrosa &c. Ne dicam quod alia germinant autumnis, et sub mitiori § caelo retinent haec folia per totam hyemem, alia vero contra.

Possunt fere omnia gramina, etiam aquatica, in eodem pulvillo seri et plantari, ubi etiam crescant. Sed mirum quomodo haec differunt quoad tempus ab iisdem in loco proprio vegetantibus. Adeoque hic plura occurrunt observanda, quam ab initio speraveram, quae non possunt absolvi omnia uno vere, sed requirerem ad minimum quatuor annos, si haec omnia rite enodarem et digne absolverem.

E.g.

Colles.	<i>Avena pratensis</i>	
	<i>Phalaris phleoides</i>	sed aprica §
	<i>Poa compressa</i>	sed arenosa
	<i>Aira flexuosa</i>	sed sylvatica
	<i>Melica § nutans ciliata</i>	sed lapillosa
	<i>Festuca ovina § decumbens</i>	sed aprica § inculta
	<i>Bromus § pinnatus tectorum</i>	sed aspera
Arenosa	<i>Briza media</i>	sed pratensi fundo §
	<i>Agrostis § arundinacea</i>	sed aspera
	<i>Aira canescens §</i>	sed aprica §
Nemorosa	<i>Bromus § secalinus</i>	sed culta
	<i>Milium effusum</i>	valde umbrosum
Fertilia	<i>Poa nemoralis</i>	valde umbrosum
	<i>Aira caespitosa</i>	
	<i>Festuca elatior</i>	sed humosa
Culta	<i>Cynosurus cristatus</i>	sed declivia
	<i>Phleum pratense</i>	
	<i>Agrostis Spica venti</i>	sed in agris
Humentia	<i>Dactylis glomerata</i>	potissimum rudrata §
	<i>Agrostis canina</i>	
Mundata	<i>Alopecurus § geniculatus</i>	
	<i>Poa annua</i>	

§ This mark has been inserted to indicate that the word is misspelled in the manuscript, and that a correction has been made.

Uliginosa	Nardus stricta	sed aspera
	Aira coerulea	
	Cynosurus coeruleus	
Aquosa	Festuca fluitans	fundo limoso
	Aira aquatica	sed aqua pura fontan.
	Poa aquatica	sed aqua profundior
	Phalaris arundinacea	sed fundo arenoso
	&c., &c., &c.,	

Si non plura hoc vero potui perquirere, didici ad minimum quomodo mea experimenta measque observationes institutam. Est profecto dignissimum argumentum et omnium maxime proficuum, cum eo innitatur tota res pecuaria. Si vixero per aliquot annos, tentabo quid vires valeant. Sunt enim gramina primarii coloni imo veri rustici terrae, quae potissimum alimentum praebent pecoribus. Herbae enim considerandae uti nobiles, quae magis ornant prata, adeoque hoc argumentum mihi e corde erit. Instituam proximo vere plantationes facile omnium nostratum in solo eorum proprio et adaequato, ut videam quomodo se gerant, nam in loco alieno vidi gramina longe prius prodire quam in proprio et vice versa cum aliis. Doleo autem magnopere quod mihi non sit terra Cretacea, ut queam rite satisfacere sapientibus anglis.

Si me dignum censeant Nobiles angli, qui inscribatur collegio et instituto Britannico, hoc maxime honorificum censeam.

Tibi commendo meum Solandrum, egregium certe et honestum juvenem.

Vale et fave Tuo,

Upsaliae 1762, d. 4 julii.

6. (A) TEMPLEMAN'S letter to LINNAEUS (Linnaeus's Correspondence, xv, f. 38^r.); and (B) an extract from VALLTRAVERS'S letter to LINNAEUS, which accompanied his Latin translation (*ibid.*, xvi, f. 18^r).

(A)

Sir,

Your Letter to Mr. Valltravers containing Observations on Grasses was communicated by him to the Society: and it was received with that Pleasure and Information which are always sure to Accompany the Writings of Dr. Linnaeus.

I am Ordered to return You the thanks of the Society for the trouble you have taken to oblige them and to Assure You that they are proud of having Your Name in the list of their Members.

Heartily Wishing You Success in Your Inquiries, and long Life and Health for the Advantage of Mankind in General, to which Your Labours have been generously devoted, I have the honour to Subscribe Myself in the Name of the Society,

Sir, Your Most Obligated Humble Servant,

PETR. TEMPLEMAN,
Secretary.

Strand, London,
Augst. 18th, 1762.

(B)

Bernae Helvetiorum, Kalendis Decembris, 1762.

Viro immortalis, Carolo Linnaeo, Equiti, S. p. d. Rodolphus a
Valletransversa.

Gratissimas Tuas, 4ti Julii elapsi, Literas, Londini accepi, paucis diebus ante abitum meum ex Anglia versus Patriam. Reliqui eam

amico intimo, qui primam arripuit occasionem, illam Societati oeconomicae Londinensi, Me absente, ante oculos ponendi. Quam grata fuerit, ex Societatis hic annexo Responso, per scribam suum, D. Doctorem Templeman, facile colliges; quod cum Anglico scriptum sit sermone, Tibi latinum reddo.

Discussion.—

In the discussion that followed Mr. T. E. JAMES expressed appreciation of the author's paper, and thought it a timely contribution respecting the friendly relations maintained between three eighteenth-century men of note of Swedish, Swiss, and Russian origin, established in many particulars through activities at the Royal Society of Arts. Rodolphe de Valltravers, a citizen of Bienne, near Berne, on election into the Royal Society of London, was described as 'a learned gentleman of Switzerland'. He had travelled much, and, although he would appear never to have published any memoir in botany or zoology, was a prominent personality in European circles, especially amongst his scientific contemporaries. Following election into the Royal Society, Valltravers visited London, taking occasion whilst there to sign the charter book. With Thomas Hollis (1720–1774), well known as a benefactor of Harvard College, Valltravers held a reciprocal regard. Hollis made him the medium for a special gift of books—of which a catalogue is extant—to the Stadtbibliothek Bern, sent in testimony of the 'brave, worthy, and free people of Switzerland'.

On property which Hollis owned at Corscombe, Dorsetshire, he caused a farm field to be named 'Valltravers', a place-name still in vogue in the Dorset countryside.

Mr. S. SAVAGE referred to the remuneration received by Linnaeus from the Demidoffs as exceptional and in all probability fixed by the latter: also, that it was to the father, Gregory Demidoff, that Linnaeus was particularly indebted for sending him so many of the plants collected in Kamtschatka and Siberia by G. W. Steller. Reference was also made to the many illnesses that afflicted Linnaeus throughout his lifetime—his survival to old age indicating a strong constitution.

ON THE NOMENCLATURE OF THE CURRANT TOMATO, *LYCOPERSICUM PIMPINELLIFOLIUM* MILL.

By T. E. T. BOND, PH.D.

(Communicated by Prof. J. R. MATTHEWS, M.A., F.L.S.)

[PLATES 4 & 5]

CONSIDERABLE confusion would appear to exist as to the correct nomenclature of the currant tomato, a species of *Lycopersicum* well known to horticulturists which has recently

come into prominence in genetical literature on account of the readiness with which it may be crossed with the ordinary large-fruited varieties of *L. esculentum*. Besides providing the material for interesting studies of linkage relationships (Sansome, 1933; Crane & Lawrence, 1934), these crosses seem likely to be of value to tomato growers in breeding for disease resistance (Langford, 1937) and other desirable qualities (Hackbarth *et al.*, 1933). The present note is intended to confirm and extend a statement made previously by the writer in 1938.

Although sufficiently distinct from the small-fruited *Lycopersicum* species mentioned by the older writers (*L. esculentum* Mill. vars. *cerasiforme* Hort. and *pyriforme* Hort. of Bailey (1922) *et al.*), the currant tomato appears to have been unknown in Britain until it was described for the first time in the seventh (1759) edition of Miller's 'Gardener's Dictionary', as follows:—

No. 4. *Lycopersicon caule inermi herbaceo, foliis inaequaliter pinnatis, foliolis obtuse-dentatis, racemis reflexis.*

Miller added that the plant was scentless and that seed had recently been sent to him from Paris under the name of *L. inodorum* Juss. De Jussieu had discovered it in Peru. In the eighth edition, of 1768 (the first in which binomial nomenclature was employed), the plant was named *L. pimpinellifolium* Mill., the diagnosis being the same as that in the previous edition except that *racemis reflexis* was altered to *racemis simplicibus*. *L. inodorum* Juss. was again given as the only synonym. Enquiries in Paris have revealed that this name is not authenticated by any specimen in de Jussieu's herbarium, and there is no evidence to show that it was ever effectively published. Accordingly, the name *L. pimpinellifolium* Mill. has been given priority. The type-specimen in the British Museum Herbarium (Plate 4, left) is marked '*Sol. Lycopersicum* Linn. var. *L. pimpinellifolium* Mill. Dict. n. 4, 1768', and is accompanied by a transcription of Miller's earlier diagnosis.

The name most commonly applied to the currant tomato by present-day European authors is *L. racemigerum* Lange (1866). Lange's original material was grown from seed received from New York. The same author later altered the name to *L. racemiforme* Lange (1872), giving an emended and detailed description which is reproduced here in a footnote*.

* *L. racemiforme* Lange, *Bot. Tidskr.* II, 1, p. 189, tab. IV. (1872).

Lycopersicum annuum, gracile, brevissime glanduloso-pubescent; caule debili, flexuoso, leviter subscandente; foliis utrinque viridibus, interrupte pinnatisectis, segmentis majoribus longe petiolulatis

Lange's account of the plant, with his figure, and also the specimens of *L. racemiforme* Lange in the Kew Herbarium (supplied from Copenhagen and signed by the author himself) have been found to agree with the type-specimen of *L. pimpinellifolium* Mill., to which reference has already been made. In England, Miller's early introduction of the currant tomato was probably unsuccessful, since no mention of it occurs in Sabine's (1819) comprehensive account nor in a later report by an anonymous author (A. F. B., 1867) of variety trials at Chiswick. Moreover, two years later (M., 1869), it was described and figured as a novelty, recently distributed under the name of *Solanum* (*Lycopersicum*) *racemigerum* by Messrs. Vilmorin. The figure given on this occasion, together with Messrs. Vilmorin's (1906) own figure published in the 'Hortus Vilmorinianus', leaves no doubt as to the identity of this plant with the species described by Lange, who probably derived his material from the same ultimate source. In one at least of Messrs. Vilmorin's earlier lists (1891), the currant tomato ('tomate groseille') appeared as '*Solanum racemiflorum* Dun.' According to Dunal's (1813) diagnosis, this is a totally different species and Messrs. Vilmorin's use of the name appears to be an error depending on its verbal similarity to *S. racemigerum*. Bailey (1922) rightly refers to the misnomer as '*S. racemiflorum* Vilm. not Dun.' The last of this group of synonyms is *Solanum racemigerum* Zodda (1905), a new combination for *Lycopersicum racemigerum* Lange associated with specimens of the currant tomato preserved in a seventeenth century herbarium from Messina, in Italy.

A further source of confusion is introduced by the use of the name *Solanum pimpinellifolium* Linn., which was first published in 1755. The species was characterized as follows :—

No. 19. Caule inermi herbaceo, foliis pinnatis integerrimis, racemis simplicibus. Hab. Peru.

This plant was considered to be closely related to *Solanum*

hastato- v. ovato-cordatis, obtusis v. (junioribus) acutiusculis, leviter sinuato-dentatis v. subintegris, minoribus interjectis brevius petiolulatis, oblique ovato-cordatis; cyma scorpioidea extrafoliacea valde elongata et racemum simulante, simplici vel rarius (semel v. bis) dichotoma, flexuosa, 15-30-flora, pedicellis 4-6''' longis, supra medium articulatis; calycis segmentis linearibus, acutis, demum reflexis; corolla lutea, calyce subduplo longiore; bacca globosa, miniata, baccae *Solani nigri* magnitudine; seminibus obovato-pyriformibus, compressis, basi longiuscule appendiculatis, apice alâ angustâ marginatis, testa laeviuscula.

Lycopersicum Linn. (= *L. esculentum* Mill.), but it was carefully distinguished by the following characters :—

- (1) Caule laevi, nec ullis pilis neque in pedunculis adspersis,
- (2) Foliis glabris, integris, cordatis, nec ullo modo incisus aut dentatis.

This account was reproduced in full in the second edition of the 'Species Plantarum' (Linnaeus, 1762). The type-specimen in the Linnaean Herbarium has been examined, and it is illustrated here in Plate 4, right. From this description, and the specimen itself, the Linnaean species would appear sufficiently distinct from the *L. pimpinellifolium* of Miller. However, the writer's own experience with the currant tomato indicates that the chief difference between these two accounts, whether the leaflets are entire at the margins or not, may possibly be somewhat unreliable, considerable variation in this character having been noticed among the different collections studied. The plants have also been found to differ in the presence or absence of hairs. In the light of this observation, it must be admitted that the dates given respectively for the introduction of these two species would have allowed for Miller having had access, via de Jussieu, to some of the material described in the original publication of Linnaeus (*Cent. I. Plantarum* . . . 1755). Apart from this possibility, there remains the fact of Miller's subsequent (1768) alteration of his account to read 'racemis simplicibus', which might have been suggested to him by the description of *S. pimpinellifolium* Linn. that was readily available in the second edition of the 'Species Plantarum'. If this had been the case, one might have expected Miller to have quoted the Linnaean species as a synonym of his own. Whatever Miller's opinion may have been, the two species soon became confused by subsequent authors. Thus, in Martyn's edition of the 'Gardener's Dictionary', in 1807, '*Solanum pimpinellifolium* L.' is characterized by a translation of the original diagnosis—'stem unarmed herbaceous, leaves pinnate quite entire, racemes simple'—and *L. pimpinellifolium* Mill. Dict. n. 4 is given as a synonym, the discrepancy between the two accounts being disregarded.

Subsequently, the name *L. pimpinellifolium* Mill. was associated with the Linnaean species by Dunal in 1813 and again in 1816. Sendtner's (1846) description in 'Flora Brasiliensis', x—'foliis aequaliter pinnatisectis, pinnis cordatis acuminatis integerrimis . . .' indicates a similar intention. In Dunal's later (1852) account, appearing in de Candolle's 'Prodromus . . .', Miller's species was excluded. Possibly, it was owing to this that Lange (1866) afterwards failed to become acquainted with Miller's description of the currant



John Bell Sons & Currier, 118 London

LYCOPERSICUM PIMPINELLIFOLIUM MILL.





3093



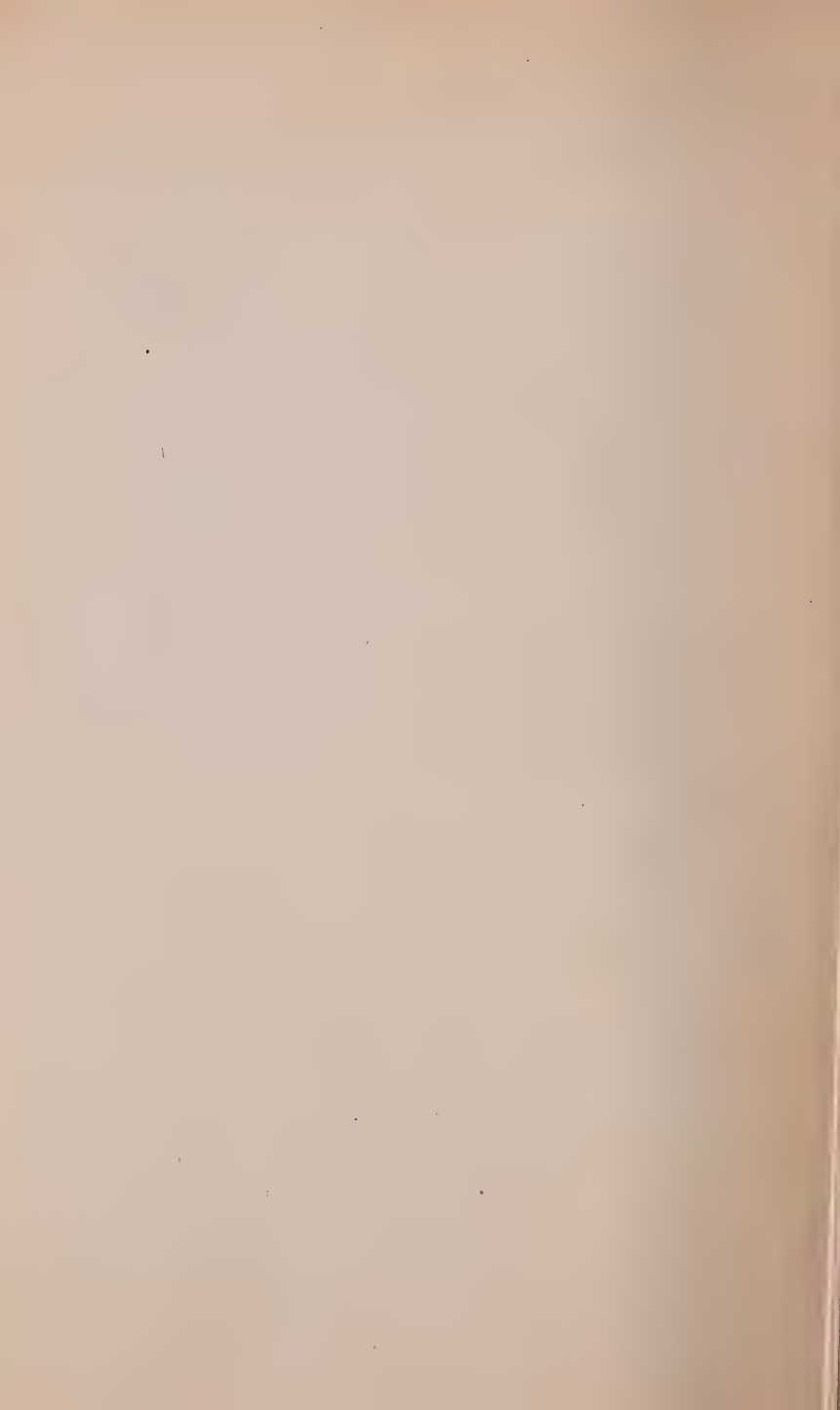
Solanum pimpinellifolium
S. elaeagnifolium
S. elaeagnifolium
S. elaeagnifolium

S. elaeagnifolium
S. elaeagnifolium
S. elaeagnifolium



John Bate-Sims & Curme, 184 London.

SOLANUM RADICANS (right) and a Specimen (left) which has been mistaken for **LYCOPERSICON PIMPINELLIFOLIUM**.



tomato, for it is this account (DC. Prodr. XIII, p. 1) that he quotes when distinguishing his own *L. racemigerum* from the other species of the genus (in 1872). Although excluding Miller's species, Dunal (1852) retained the name *L. pimpinellifolium*, and it must here be regarded as a new combination for *Solanum pimpinellifolium* Linn. This combination *L. pimpinellifolium* (Linn.) Dun. must be rejected as it is a later homonym of *L. pimpinellifolium* Mill., being based on a different type. It is employed among recent authors by Bailey (1922). Sturtevant (1919), on the other hand, follows Dunal's earlier (1813-16) usage in employing the name *L. pimpinellifolium* Mill., while referring to the description (of *Solanum pimpinellifolium* Linn.) in the second edition of the 'Species Plantarum'.

So far, only a single authentic specimen of *Solanum pimpinellifolium* Linn. has been seen, namely, the type-specimen in the Linnaean Herbarium (Plate 4, right). The single specimen under this name in the British Museum Herbarium (Plate 5, left), which dates from the eighteenth century and would therefore have been available for Dunal's inspection, is quite distinct. Actually, it is strongly suggestive of another Linnaean species of which the type-specimen has been examined, namely *S. radicans* Linn. (Plate 5, right), which is characterized as follows:—'. . . foliis in petiolum decurrentibus profunde pinnatifidis 5-7-lobatis, sinibus rotundatis, laciniis elongatis ovato-acuminatis basi attenuatis acutis, terminali majore . . .' (DC. Prodr. XIII, 1, p. 71). The question of the true identity of *S. pimpinellifolium* Linn. and its relationship with the currant tomato must therefore await the examination of further specimens and, if possible, the occurrence of living material agreeing with the original description. Circumstantial evidence supporting Dunal's transfer of the species to the genus *Lycopersicum* is provided by the original author's assumption of its close relationship with the tomato, *L. esculentum* Mill. Even so, assuming it to be distinct from the currant tomato, the requirements of the International Rules of Botanical Nomenclature indicate the necessity for giving it a new specific name, *L. pimpinellifolium* Mill. having priority over any subsequent *L. pimpinellifolium*. There is no evidence that *L. pimpinellifolium* Mill. was intended as a new combination for *Solanum pimpinellifolium* Linn., and the former name stands even if further investigation should prove that the two species are actually identical. Thus, the correct name of the currant tomato is *L. pimpinellifolium* Mill. *L. pimpinellifolium* (Linn.) Dun. in any case is a later homonym and must be rejected, while *L. racemigerum* Lange, *L. racemiforme* Lange, and '*Solanum racemigerum*' (Sansome, 1933) are taxonomic synonyms, and their use should be avoided.

Dunal (1852), in his later account, was inclined to regard *L. pimpinellifolium* Mill. as identical with his own recently proposed *L. Humboldtii*. The latter species, however, is closer to the well-known cherry tomato (*L. esculentum* Mill. var. *cerasiforme* Hort. or *L. cerasiforme* Dun.), from which it differs principally in having smaller inflorescences and flowers and relatively shorter calyx teeth. As Lange (1872) was careful to point out, it can be distinguished from the currant tomato by the characters of its inflorescence and fruit and also by the possession of hairy stems with acuminate leaves which are bluish green on the under surface. Further, the seeds, which in the currant tomato are smooth, slightly winged at the apex, are hairy and papillate in *L. Humboldtii*, as in the varieties of *L. esculentum*. The currant tomato also differs sharply in the absence of the strong odour which is characteristic of those species.

Grateful acknowledgment is made of the assistance and information supplied by the Linnean Society of London, and by the authorities in charge of the Herbaria at Kew, the British Museum, Paris, and Copenhagen. The writer is indebted to Prof. F. T. Brooks and to Prof. J. R. Matthews for their valuable suggestions and helpful criticism. The photographs are reproduced by kind permission of the authorities concerned.

LIST OF WORKS REFERRED TO.

- A. F. B. 1867. (Variety trial at Chiswick.) *Florist and Pomologist*, (1) VI, pp. 238-40.
- BAILEY, L. H. 1922. *The Standard Cyclopaedia of Horticulture*. New York.
- BOND, T. E. T. 1938. Infection experiments with *Cladosporium fulvum* Cooke and related species. *Ann. appl. Biol.* xxv, pt. 2.
- CRANE, M. B., & W. J. C. LAWRENCE. 1934. *The Genetics of Garden Plants*. London.
- DUNAL, M. F. 1813. *Histoire naturelle, médicale et économique des Solanum et des genres qui ont été confondus avec eux*. Paris.
- 1816. *Solanorum generumque affinium Synopsis* . . . Montpelier.
- 1852. *Solanaceae*, in de Candolle's *Prodromus Systematis naturalis Regni vegetabilis* . . ., XIII, pt. 1.
- HACKBARTH, J., N. LOSCHAKOWA-HASENBUSCH, and R. v. SENGSBUSCH. 1933. Die Züchtung frühreifer Tomaten mittels Kreuzungen zwischen *Solanum lycopersicum* und *Solanum racemigerum*. *Züchter*, v, pp. 97-105.
- LANGE, J. 1866. *Index Seminum in Horto Academico Havniensi a. 1865 collectorum*. Copenhagen.
- 1872. Udvalg af de i Kjøbenhavns botaniske haver frøfortegnelser fra 1854-70 beskrevne nye arter paa ny gennemgaaede og oplyste ved afbildninger. *Bot. Tidsskr.* ser. 2, i, pp. 177-93.
- LANGFORD, A. N. 1937. The parasitism of *Cladosporium fulvum* Cooke and the genetics of resistance to it. *Canadian Journ. Res.* (Sec. C), xv, pp. 108-28.

- LINNAEUS, C. 1755. Centuria I. Plantarum . . . Abrah. D. Juslenio, in *Amoen. Acad.* iv, pp. 261-96.
- 1762. *Species Plantarum* . . . ed. ii.
- M. 1869. (Ornamental varieties of tomatoes.) *Florist and Pomologist*, (3) II, pp. 73-4.
- MILLER, PHILIP. 1759-1807. *The Gardener's Dictionary* . . . 7th ed. 1759: 8th edition, 1768: Martyn's edition, 1807.
- SABINE, J. 1819. On the love apple or tomato. *Trans. hort. Soc.* III, pp. 342-54.
- SANSOME, F. W. 1933. Chromatid segregation in *Solanum Lycopersicum*. *Journ. Genet.* XXVII, pp. 105-32.
- SENDTNER, O. 1846. *Solanaceae, Cestrineae. Martii Flora Brasiliensis*, vol. x.
- STURTEVANT, E. L. 1919. *Sturtevant's Notes on Edible Plants*. Edited by U. P. Hedrick. *Rep. N.Y. Agric. Exp. Sta.* XXVII, vol. ii, pt. 2.
- VILMORIN-ANDRIEUX ET CIE. 1891. *Les Plantes Potagères*. 2me éd. Paris.
- 1906. *Hortus Vilmorinianus*. Appendix to *Bull. Soc. bot. France*, LI.
- ZODDA, G. 1905. Illustrazione di un erbario messinese del secolo XVII. *Ann. Bot. Roma*, II, pp. 251-84.

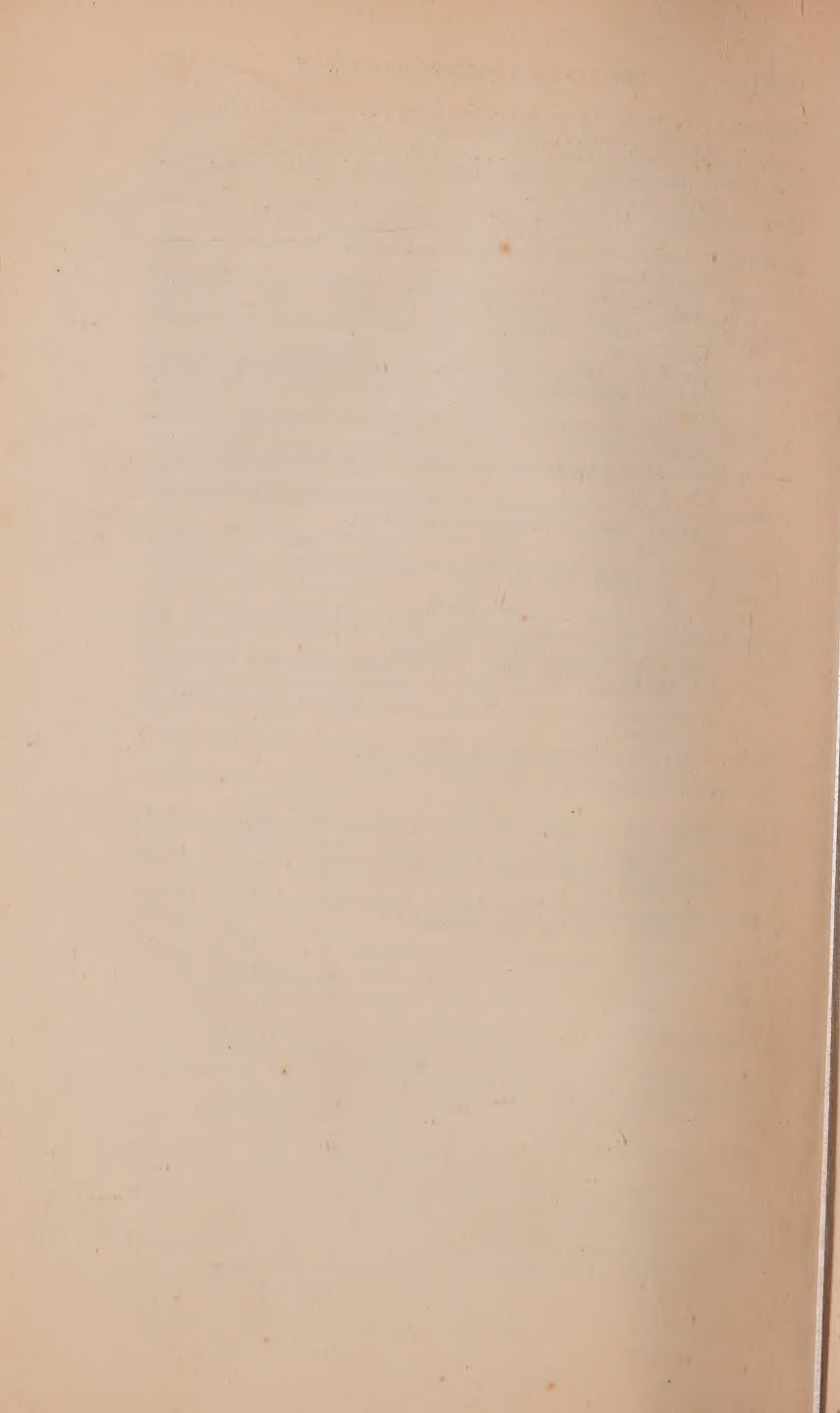
EXPLANATION OF THE PLATES.

PLATE 4.

- Left. *Lycopersicum pimpinellifolium* Mill. Type-specimen in the British Museum (Natural History).
(' *Sol. Lycopersicum* Linn. var. *L. pimpinellifolium* Mill. Dict. n. 4, 1768': ' *Lycopersicon* caule inermi herbaceo, foliis inaequaliter pinnatis, foliolis obtuse dentatis, racemis reflexis. P. Miller'.)
- Right. *Solanum pimpinellifolium* Herb. Linn. (' *pimpinellifolium*': 'Peru'). On the same scale as fig. 1.

PLATE 5.

- Left. From the British Museum (Natural History). ('3093': ' *Solanum pimpinellifolium* caule inermi herbaceo, foliis pinnatis integerrimis, racemis simplicibus. Lin. Spec. Plant. p. 265, 1783'.)
- Right. *Solanum radicans* Herb. Linn. (' *S. radicans*': 'HU.') On the same scale as the other figure.



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